PRODUCTION's Manufacturing PLANBOOK 1978

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PRODUCTION's Manufacturing PLANBOOK: 1978

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Black & Decker's Air Tool Division discovers Rathbone's Cold Draw, and saves a pile on time, cost and material.

Producing the part above used to be time-consuming, costly and wasteful. Then Black & Decker met Rathbone.

Production time: down from 14 to 4 weeks

The part is a clutch dog—a key component in one of Black & Decker's rugged automotive impact wrenches. In the past, it was rough forged and broached to the profile tolerance.

Now, however, Black & Decker is using shaped rod cold-rolled and drawn by Rathbone into continuous, uniform-profile bars 10 feet long and with a .002" geometric tolerance. Result: internal production time for an inventory supply of clutch dogs has been reduced from 14 to 4 weeks.

Component cost reduced 50%

Using cold-drawn alloy steel meeting its exact strength and wear requirements, Black & Decker produces reliable clutch dogs measuring 1-5/16" and 3/4" long. Finishing operations include drilling, deburring, milling, hardening and grinding. The overall cost of the components has been cut 50%, and Black & Decker has held the line on unit selling prices.

Scrap rate cut from 10% to 4%

Last but not least are the savings achieved in materials. Since individual components are not machined from start to finish, but are simply sliced from the bars and finish machined, material loss is minimal. The fact is, under the present system this major manufacturer has cut its scrap loss from 10% to 4%.

Black & Decker has shown the way. If your needs fall within a size limitation of 1/32"–1-1/2" OD and a minimum of 1000 lbs., Rathbone precision cold-drawn shapes can actually extend your design and production capabilities. Contact us now, and we'll show you exactly how. Rathbone Corporation, Palmer, Mass. 01069; tel. (413) 283-8961.

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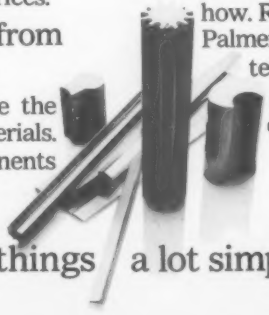

Rathbone's Cold Draw. It makes things a lot simpler.

CIRCLE NO. 5 ON READER INQUIRY CARD

EDITORIAL

PLANNING: 1978

This is the fifth annual Manufacturing PLANBOOK. Reader response to its predecessors indicate it will be one of the magazines manufacturing readers use most this year. We hope it serves you well. We welcome your comments, and particularly your suggestions on how the book could be improved.

Manufacturing PLANBOOK: 1978 has nine technical sections. Each is designed to supply you information and ideas to make your planning easier. They are not "stories." They are working tools. Our annual Capital Spending Study indicates that if your company is typical, you'll have 4.6 percent more dollars to spend for capital equipment this year than last. That may mean an extra project or two gets approved.

In addition, you'll find four special reference sheets and 65 recent PRODUCTION feature articles which you may request by circling the appropriate number on the Reader Inquiry Card.

In summary, this issue's single mission is to assist you in making your manufacturing plans and decisions. We hope you will find in it new and useful information to help you tackle the challenges of your job in 1978.

The Editors

HOW TO MANAGE CREATIVITY

...your own and that of others

by Ted Pollock

People are 95 percent alike. They share the same basic wants, needs, and yearnings—food, shelter, clothing, safety. They raise families, enjoy the company of others, seek a little pleasure, try to find a place in the world.

It is the unique 5 percent in their makeup that differentiates one person from another, the saint from the sinner, the towering intellectual from the dullard, the leader from the led.

Since we are basically the same physically, what individualizes us must be found elsewhere. Call it what you will—mind, spirit, personality—there is something intangible but nevertheless real that makes Bob Smith different from Joe Jones and Mary Brown different from Susan Green. And it is these differences—in talent, temperament, interests, attitudes, ambitions, and values—among employees that make the manager's job so challenging.

Nowhere, perhaps, are these differences so evident as in the area of creativity.

What Creativity Is

There is no completely satisfactory definition of creativity. What, after all, do Michaelangelo, Henry Ford, Laurence Olivier, and the man who solves a tricky manufacturing problem have in common? A high I.Q.? Vaulting imagination? Curiosity? Inordinate patience? Stubbornness? A little, or a lot, of each of these things? No one really knows, although many have tried to isolate the individual components of original thought. The problem is that no matter what sort of list is drawn up, exceptions to the "rules" immediately come to mind.

Nevertheless, creative people do tend to have certain things in common and the manager who wishes to get the best out of such employees would be well advised to understand what makes them "tick," the kind of environment they thrive in, how to adjust his or her needs to theirs. A subsidiary benefit is the strong likelihood that, in the course of providing the kind of management atmosphere in which originality can flourish, you increase your chances of encouraging more creativity not only from the relatively few with a strong predisposition for originality, but from *all* your people.

The first question that suggests itself is, *Is that desirable?* After all, many jobs seem to require precious little independent thought. Why rock the boat?

There are three answers. First, there isn't a job you can name that cannot be done better in some way, whether it's more quickly, more accurately, or less wastefully. Employees who understand that you welcome fresh ideas will seek them out. Second, even if an employee whose creativity is encouraged cannot find ways to do his own job more effectively, he may identify some altogether unrelated area where improvements can be made. Creativity is not easily confined or compartmentalized; it tends to spill over and surprise. Third—and this may be the most overlooked factor of all—approaching work with a creative attitude makes that work interesting and enjoyable. On the surface, many jobs appear cut and dried. Viewed creatively, they can be transformed into tantalizing challenges. And what challenges and teases us is almost always more interesting than what does not.

If we agree, then, that creativity in employees is desirable and ought to be fostered, how do we recognize it?

Creative talent manifests itself in many ways. One person may possess an uncanny ability for solving mechanical problems. Another may be able to identify weaknesses in someone else's ideas. A third may have a genius for managing resources. Who can say which one is most creative?

As a rule of thumb, creativity may be defined as *any activity which results in something new or different that ultimately is beneficial to others.* It may be a theory, artistic creation, invention, process, solution to a problem, or any of a thousand things. It may range

from applying an old idea to a new situation to the promulgation of a totally unprecedented view of the universe. But in one way or another, its product is something that did not exist before.

DO'S AND DONT'S FOR MANAGING THE CREATIVE EMPLOYEE

DO

- Establish a colleague relationship.
- Explain your needs.
- Set clear objectives and mutually agreeable deadlines.
- Provide a comfortable work environment free of distractions.
- Listen to his ideas with an open mind.
- Criticize constructively.
- Show tolerance for failure.
- Ask only for those reports you really need.
- Let him know the status of his idea once it has been submitted.
- Give credit and recognition when a job is well done.

DON'T

- View him as a threat to your department's harmony.
- Breathe down his neck in an effort to keep him on deadline.
- Ignore his needs for privacy, time, encouragement.
- Expect him to behave precisely like everyone else.
- Deny him access to people or equipment.
- Make him constantly aware of status.
- Discourage him with skepticism, ridicule, lack of enthusiasm.
- Badger him for reports which will be promptly filed and forgotten.

How Creative People "Tick"

The very word *creativity* conjures up images of the handful of giants who have shaped our world—Plato, Aristotle, Descartes, Jefferson, Shakespeare, Curie, Einstein, Freud, and so on. Certainly, those names suggest lives devoted to high intellectual pursuits, and there is no comparison between founding a school of philosophy and contriving a new way to manufacture widgits. But in both instances virtually the same creative process is at work. There is, first of all, dissatisfaction with the *status quo*. A problem or need is identified. There is a search for possible answers; a great deal of random thinking, both conscious and unconscious; a gradual narrowing of focus on essentials; experimentation with possible solutions; and, finally, the pinpointing of the best possible answer.

Almost by definition, creative people are unique, for they ask questions no one has asked before. Nevertheless, they do share a number of common characteristics. Not *all* creative people, to be sure, share *all* these traits, but they tend to have most of the following in common.

1. *Drive.* The creative are highly self-motivated. Nothing galvanizes them so much as a challenge. Once intrigued by a problem, they can summon enormous bursts of energy and concentration for long periods of time in their pursuit of answers. They will eat, drink, and breathe the problem at hand, talking and thinking of nothing else. A kind of monomania sets in and any demands on their time that drag them away from the problem or project are viewed with loathing. They want to be left alone to wrestle with the challenge.

2. *Perseverance.* The more creative a person, the higher his or her "frustration tolerance." Thomas Edison's patience was lengendary. He never viewed an experiment that failed as a waste of time. Rather, his attitude was, "Well, that's one approach I needn't try again." Once convinced that finding the answer is worthwhile, a creator will take infinite pains and whatever time is necessary to conclude his work successfully.

3. *Curiosity.* Creative people like to know the why's, what's and wherefore's of things. They are nosey, inquisitive, eclectic. Brief answers seldom satisfy them and the more complete the answers they get, the more questions they come up with.

4. *Wide interests.* Being curious, the creative are interested in many things aside from their specialties and read widely outside their fields. The truly inventive engineer, for instance, may also study judo, marine biology, music, gourmet cooking, and ways to beat the blackjack dealer in gambling casinos. At social gatherings, creative people will frequently buttonhole those in different lines of work and assault them with questions about their jobs. They are receptive to new information, fresh ideas, outlandish theories, novel ways of looking at things, for they never know when something they see or hear may trigger an idea.

5. *Self-confidence.* The creative have great belief in themselves and their ability to overcome obstacles. They also have a high regard for their worth. Indeed, they may appear to possess towering egos and, to be sure, some do. But it is often less a case of egotism than belief in the power of approaching problems positively, as if failure were out of the question. Charles Kettering, for example, wanted to make an electric starter for automobiles, but every engineer showed him why he couldn't possibly do it. A motor powerful enough to turn a gasoline engine would be as big as the engine and need a battery as big as the car. He tried many approaches before it occurred to him that maybe that answer was false. He didn't want

to turn the engine by the motor very long—just for a few seconds, to start it. Every engineer figured on a motor and battery big enough for "continuous load." Kettering saw that the load would be only momentary; so he designed a small motor and battery that would turn the engine for only a moment, just long enough to start it.

6. *Observation.* Generally, creative people see things that others do not—similarities, analogies, parallels. When working on an idea, they have a knack for considering everything they see, read, and experience in terms of, "How can I use that? Can it be adapted, modified or combined with something else to solve my problem?" There is a ceaseless search for new applications of old principles.

7. *Imagination.* Most creative men and women live in a world of "Suppose I did this . . . ?" "What if we tried that . . .?" "Why not do it this way . . . ?" They continually play with ideas and notions, dismissing nothing until they're convinced it is of no value.

8. *Intuition.* Creative people are often impelled to act on a "hunch." True, their hunches are almost always based on an amalgam of forgotten experience and unfettered imagination, but they get "feelings" that cannot be explained away intellectually. Many highly creative people have referred to this phenomenon. Listen to these. Albert Einstein: "At times I feel certain I am right while not knowing the reason." Irving Langmuir, Nobel laureate in chemistry: "It is absurd to think that reason should be our guide in all cases. Reason is too slow and too difficult. . . . We underrate the importance of intuition." Thomas Edision: "The key to successful methods comes right out of the air. A real, new thing like an idea, a beautiful melody, is pulled out of space."

9. *Sense of humor.* As you might suspect, people who are adept at seeing similarities between dissimilar things and extracting general principles from concrete instances also enjoy the surprise in a funny story, the unexpected twist in a clever pun, the irreverance that is part of humor. Wit, which largely depends on the startling juxtaposition of dissimilar ideas, appeals to them. And, of course, humor helps them deal with the failures that are necessary preludes to success in the creative process.

10. *Idiosyncrasy.* Not surprisingly, people who are unconventional in their thinking are frequently also unconventional in their behavior. They may dress differently from their peers, be chronically late for appointments, ignore standard operating procedures. True, some very pedestrian people affect these external signs of being different and not every eccentric is creative, but more often than not creative people *do* march to a different drummer and it shows in their behavior.

Lest these characteristics give the impression that creative people are a breed apart, not subject to the same motivations and laws as lesser mortals, let's recognize that *in addition to the above,* they can also be lazy, uncooperative, sullen, jealous, unproductive, petty, ornery, and frustrating to work with. What chiefly differentiates them from others are a few extra wrinkles in their brains. Those wrinkles make a big difference, but they do not represent grounds for amnesty-in-advance for boorish, uncooperative, or prima-donna-like behavior. Something to bear in mind.

The Creative Climate

Given such people, in what kind of environment might they be expected to thrive? What do they require in order to mine their own creativity most effectively?

The first need is to be alone, at least part of the time, in order to think. A man or woman in the grip of a perplexing problem needs solitude to summon whatever inner resources may be necessary to solve the problem. Almost universally idea people report getting their best ideas in solitude—while driving, shaving, raking leaves, baking bread, and the like. There appears to be a very real need to be removed from distractions, particularly noise and movement. This is not to say that a creator must work in a vacuum, but he should have several quiet hours daily at his disposal. No truly great idea ever emerged from a committee.

A second need is for unstructured time. Although it is close to blasphemy in the western ethic to do "nothing," inactivity appears to be a prerequisite for creativity. Brain activity is invisible to the naked eye and the person who to all outward appearances is daydreaming may be in the throes of working out a complex problem. Most good ideas are the result of slow simmering, a period of gestation during which memory, experience, imagination, and fantasy are allowed to work their magic.

A third need is naivete, a kind of pristine gullibility that suspends judgment and rules out criticism. The ideal creative environment is free of rejection. For a period of time during the creative process, anything is considered within the realm of possibility—the suspension of the law of gravity, the transmutation of lead into gold, traveling faster than the speed of light, *anything.*

A fourth need is for a combination of alertness and discipline. These are necessary prerequisites for all productive work, of course, but they assume a particular importance in the creative act. They are often the conditions that enable the creator to recognize—after a period of prolonged gestation—the existence of a particular similarity between two or more phenomena that had previously escaped notice. Translated into environmental terms, they require a climate of free time and good physical working conditions—adequate lighting, ventilation, the absence of distractions.

Additional needs vary from individual to individual. Some people get their best ideas while soaking in a hot tub; others, while getting their hair cut. But the four conditions cited above appear to be the bedrock basics of the general climate most conducive to creativity.

Managing Creative People

If creative people are so special and require a hothouse environment worthy of an exotic orchid, how can a manger whose job is to get things done ever hope to manage them successfully? Must they continually be catered to, stroked, and treated differently from other employees? Is it fair to treat some employees differently from others? If the creators are given free rein to put their feet up on their desks, gaze dreamily into space, and simply think, what will happen to productivity, not to mention morale?

Clearly, needs differ from situation to situation. If you are managing an R&D installation where creativity is the mission and one good idea can ultimately be worth millions of dollars to your company, the answer is—give your creative people everything they need. If you manage a department responsible for so much output per week, month, or quarter, obviously you must find a happy compromise between encouraging originality and getting the work done. You must decide the relative importance of creativity to your major responsibilities and how much of your resources can be prudently invested in promoting inventiveness. It's a question of priorities.

Ideally, however, here are some guidelines for managing creative people. Bearing in mind the realities of your own situation—headcount, resources, mission—use them as common sense dictates.

1. *Establish a colleague relationship.* Creative people are more achievement-oriented than company-oriented. Their loyalty is to their profession, not to the organization that pays their salary. They bridle at rules and regulations that they view as interferences with their pursuit of ideas. It is useless to tell them, "Do it this way because that's the way we do things here." The manager accustomed to having

HOW CREATIVE ARE YOU?

"It takes one to know one" was never so true as in the case of creativity. If you have a bent for originality, chances are you are sympathetic toward others with a similar proclivity and your management style shows it.

Are you an originator? This quiz should give you some idea and indicate areas where you might improve.

1. Do you ever challenge company policies or methods?
2. Deep down, do you fear ridicule of your ideas?
3. Do you enjoy experimenting with new methods and techniques?
4. Do ideas excite you?
5. Do you ever discuss your problems with friends, asking them for suggestions and new points of view?
6. When something makes you mad, or takes too long, or costs too much, or is wasteful, or just plain dumb, do you simply mutter about it—or recognize it as a fertile area for investigating possible improvements?
7. Are you stubborn in the best sense of the word, unwilling to give up when something has you stymied?
8. Do you manage to structure yourself some time during your work day for the express purpose of doing some thinking?
9. Do you reserve judgment while creating, concentrating on quantity and variety rather than on quality?
10. Have you identified the people in your company whose knowledge and advice can be drawn upon from time to time to prime the wells of your own thinking?
11. Do you read widely, outside your own specialty?
12. Are you familiar with the research facilities at your disposal within a 25-mile or so radius of your office—e.g., public libraries, university facilities. specialized business or research libraries?
13. Are you tolerant of new, untried ideas, regardless of their origin?
14. If an idea doesn't work, do you dismiss it out of hand, or tinker with it to see if it can be salvaged?
15. Are you aware of any prejudices or preconceived notions that inhibit your ability to think creatively—e.g., discounting the ability of others . . . assuming that certain facts are unobtainable . . . lack of self-confidence? If you are aware of them, do you take them into consideration while in the throes of creation?
16. When faced with a problem, do you try to isolate the key element, on the supposition that if you can crack it, everything else will fall into place?
17. Do you periodically gather your people together in order to cross-pollinize their thinking—and yours?
18. Do your people think of you as being receptive to fresh ideas?
19. Do you maintain an up-to-date collection of books and articles that you find especially stimulating or that apply specifically to your job and the kinds of problems you are apt to encounter?
20. Do you have a reputation as an "idea person"?

his way simply because he's the manager and subordinates are supposed to obey their managers is due for a shock. The creator could not care less for titles, so don't hide behind yours and thunder *diktats* from Mt. Olympus; rather, *explain with facts and logic* why he should do something and he'll listen with respect. What he seeks and responds to is not the conventional boss-subordinate relationship, but a colleague relationship, based on free wheeling discussion and constructive criticism. Confront him (or her) with unilateral decisions requiring unquestioning obedience and he will (1) tune you out or (2) go his merry way to a company he finds more compatible.

2. *Suspend critical judgment.* A good idea is sometimes hampered in its early stages because the form in which it is initially expressed is weak and unconvincing. The originator may not be able to sell an idea, or not yet have worked out all the bugs. But don't confuse the presentation with the idea itself. A chemist with only a so-so ability to explain things may pop up with the ideal solution to a problem in distillation. The painfully shy accountant who stutters *could* produce a new way to finance your expansion program. Even "far-out" ideas may contain the germ of solid thinking—if you can separate the wheat from the chaff. That's why it is important that you view *every* idea as a potential winner. Granted, to turn an idea into usable shape, you may have to add, subtract, modify, or combine it with additional ideas. In such a case the original idea may, in retrospect, become merely a jumping-off point. But without it, you would get nowhere. Be slow, therefore, to condemn any idea to oblivion. If it is not feasible today, it may be eminently practical tomorrow or next year. Even if it appears unusable, the "secret ingredient" needed to transform it into solid gold may pop up in the future. Help make his idea work and the creator will be in your debt.

3. *Establish mutually acceptable deadlines.* Most people work best against deadlines and creative people are no exception. In fact, because they are apt to grow enamored of a particular problem to the exclusion of all other considerations, creators are prone to piddle away their time in endless elaborations and refinements of an idea. Deadlines establish a sense of urgency that impels them to keep on track. If a project is large or complicated, interim deadlines that require progress reports may also be necessary. But deadlines that are set arbitrarily—or appear to be—will probably be ignored. To assure cooperation, meet with the individual at the start of a job and reach agreement on goals, budget limitations, resources available, how long it should take, interim dates for progress reports, and a firm date for completion.

4. *Maintain contact.* Although a manager shouldn't breathe down a creative employee's neck during a project, good supervision is critical to any person's productivity. Use those interim dates and checkpoints on the work schedule to talk over unexpected problems that may be holding up progress.

5. *Give them a chance to fail.* Failure is a recognized stepping stone toward ultimate success in the creative process, but anathema to the businessman who necessarily bears a "bottom line" responsibility. The manager of creative people must go out of his way to be supportive during the trying period of failure and demonstrate that he doesn't consider it the end of the world. If he doesn't, fear of failure may prevent true initiative. A few words of encouragement . . . a suggestion as to how to proceed or whom to talk to . . . simply listening can pay big dividends in the long run.

6. *Grant them some time off.* We have already discussed the need for solitude that creative people have.

WHEN YOU MUST CRITICIZE

Creative employees may be different from others in many ways, but *all* people respond to criticism in much the same way. Some time ago, in order to measure the precise effects of various forms of criticism on human performance, a team of psychologists asked for volunteers at a large university. When they had a sufficient number of subjects, the researchers divided them into seven groups and gave each group the same series of challenging tasks to perform.

As each group completed its first set of tasks, it was briefed on its performance. But each group was told in a different way. One group was praised in front of others; another was ridiculed in private; still another was publicly reprimanded; and so on. The tests were then continued.

In simple chart form, here is a rundown of the performances on that second series of tests.

Incentive Method Used After First Series of Tests	Percentage Showing Better Results On Second Series of Tests
Public praise	**87.5**
Private reprimand	**66.3**
Public reprimand	**34.7**
Private ridicule	**32.5**
Public ridicule	**17.0**
Private sarcasm	**27.9**
Public sarcasm	**11.9**

While public praise was the most effective incentive of all, invariably, you will notice, private criticism produced better results than public criticism. That is, the private reprimand outproduced the public reprimand; private ridicule achieved results superior to public ridicule; even sarcasm was far more effective when delivered in private than in public.

The moral for the manager would appear to be crystal clear: *keep your criticism private.*

THREE NEEDS THAT STIFLE CREATIVITY

There is no way of estimating how many good ideas have been stillborn because of managerial timidity. It can take many forms: "Forget it." "Too impractical." "Can't possibly work." "We've never done that before." There are three needs that frequently underlie the manager's reluctance to encourage originality. If any of them strike a chord, it may be time to review your own "mental sets."

1. *The need for the familiar.* All of us are habit prone. We become attached to certain time-tested methods of performing certain tasks. When something new is called for, a conflict arises between the old, accepted methods and different or untried modes of operation. The non-creative manager will usually stick to the time-proven methods, while the creative manager will actively seek new avenues of approach.

2. *The need for excessive order.* Closely associated with the need to adhere to the familiar is this creative barrier. Managers afflicted with this "hardening of the categories" accept only that information which fits pre-exisitng classifications. They tend to reject new ideas that do not have a ready-made slot. On the other hand, the creative manager makes a conscious effort to ignore time-proven slots and examines a new idea strictly on its own merits.

3. *The need to conform.* This need is characterized by such feelings as "curiosity killed the cat," "bet on a sure thing" and "better safe than sorry." The manager who believes in these aphorisms is expressing the exact opposite of the freedom from conformity.

This doesn't imply that to be creative is to make a concerted effort to be different for its own sake. It simply implies a willingness to take calculated risks and accept the possibility of being wrong.

Some of the best ideas come during idle periods immediately following stretches of intense concentration. Sudden insights frequently emerge from a subconscious mind that, until recently, was totally occupied. Since ideas are often born in the least likely circumstances and places, it is less important for the creator to be in a certain place at a certain time than it is to work under optimum conditions. An occasional "Take the rest of the day off" or "Why not work on it at home on Monday?" can go a long way toward increasing the productivity of creative people.

7. *Give recognition.* You like to get credit for your ideas. So do your creative people. Be quick, therefore, to show appreciation for good work and see to it that individuals receive the proper acknowledgment for their ideas, whether it takes the form of a bonus, prize, raise, scroll—or the simple public expression, "Well done!"

Such rewards are not only just and proper; they are extremely practical. Recognition tends to raise employee standards. Next time they will try to equal or surpass the good job they did this time. And those who witness the recognition will be spurred on to greater effort. A little friendly competition never hurt anyone.

8. *Bend the rules.* Every organization has its regulations, but it also accumulates a lot of red tape over the years. The creative usually detest paper work, going through channels, and all the other paraphernalia of bureaucracy. They can drive managers up the wall with their erratic ways, but once you understand the iron grip that the pursuit of an idea can have on them, you may be a bit more sympathetic toward their sense of priorities. Bearing in mind the needs of your company, when possible smooth their way by not insisting that they "go by the book" in every instance.

9. *Follow through on ideas.* A creator's idea is like a woman's child. He wants to know how his "baby" is doing at all times.

Don't disappoint him. Attend promptly to the ideas that your creative people come up with and provide them with regular feedback on what is happening to their ideas, when they are going to be evaluated, and by whom.

If the idea is under serious consideration, tell the originator so. If it has run into some problem, explain that, too. If certain flaws have cropped up, describe them; he may have the answer. At the very least, he will understand why his idea is not being adopted.

The important thing is to prove to your employees that all their ideas are taken seriously. Thus assured, they will do their best to come up with more, and better, ideas.

10. *Don't be a creativity killer.* Unwittingly, a lot of managers are idea killers. Some are snobs who think, "If Jones could dream up good ideas, he wouldn't be working for me in the first place." But everybody has to start someplace. Jones just might have the answer to a nagging problem. He deserves a hearing.

Others are so mundane in their own thinking that they are jealous of anyone who shows a spark of creativity.

Still others don't want to rock the boat . . . view every idea as a threat to their own position . . . honestly, but erroneously, believe that theirs is the best of all possible worlds.

And there are those who have difficulty in recognizing a good idea when they see one. Unless the idea is presented in highly polished, flawless form, they dismiss it as worthless.

The solution? Take stock of yourself as a judge of ideas. If, upon analysis, you discover that you tend to quash ideas for any reason besides their lack of intrinsic merit, consciously try to suppress the personal prejudices that are costing you good ideas. □

We've learned a lot over the years about planning and building manufacturing systems for diesel engines...

We've learned, for example, that a key factor in planning more productive systems is in taking the transfer line technology that's available today and putting it together in new and better ways. Traditional concepts for organizing the myriad pieces of a complex system are undergoing radical change. Using programmed computer simulation, we've learned how to test alternate mixes of equipment and techniques to search out potential problems and to develop the right solutions long before going to the drawing boards. We've learned more about the important concept of line-balancing to assure improved unit flow. We've learned the best ways to plan for the number, size, and location of storage banks. We've studied tool changing methods and we've learned how each of these methods impacts on a system's performance. We've learned more about cycle rates and net production rates for both low and high-volume systems . . . about operating efficiencies, systems management, and electronic programmed control. We've learned how automatic gaging of machined surfaces can be combined in a variety of ways with automatic adjustment of tools for wear compensation, to improve parts quality. And we've learned much more.

Worldwide demand for diesel engines and related power train parts has been doubling. That kind of growth in demand, coupled with the rapidly changing technology of diesel engine manufacturing, points to the need for greater-than-ever investment in new and more sophisticated production machinery by the world's engine builders. We've learned a lot by helping them.

...perhaps our people should be talking to yours.

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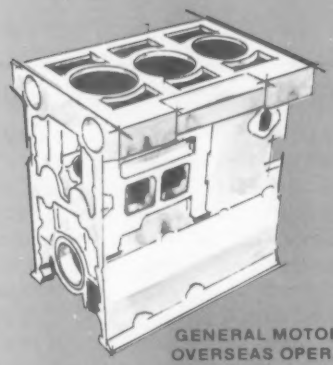

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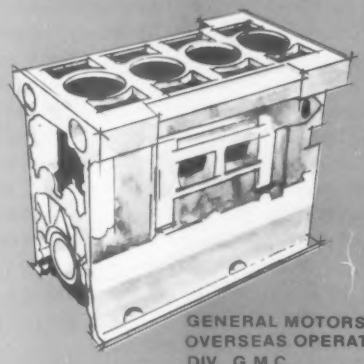
L-3 Engine Block



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OVERSEAS OPERATIONS
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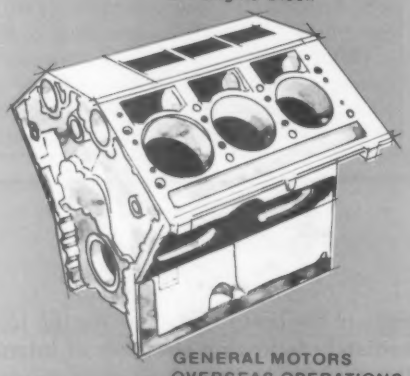
L-4 Engine Block (shown)

CATERPILLAR TRACTOR CO.
L-4 Engine Block



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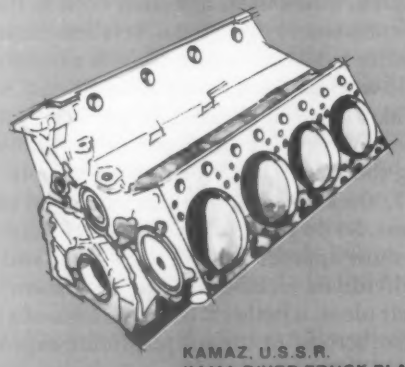
OVERSEAS OPERATIONS
DIV., G.M.C.
V-6 Engine Block



KAMAZ, U.S.S.R.
KAMA RIVER TRUCK PLANT
V-8 Engine Block

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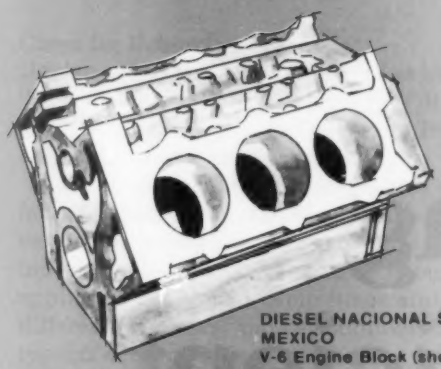
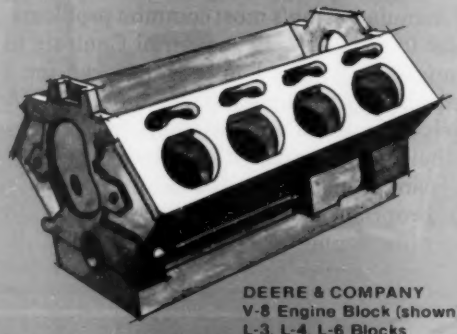


DIESEL NACIONAL S.A.
MEXICO
V-6 Engine Block (shown)

FIAT, ITALY
V-6 Engine Block

DIESEL NACIONAL S.A.
MEXICO
V-8 Engine Block (shown)

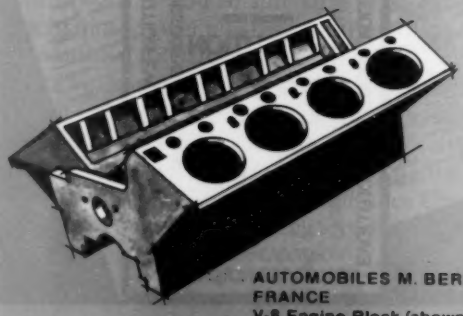
FIAT, ITALY
V-8 Engine Block



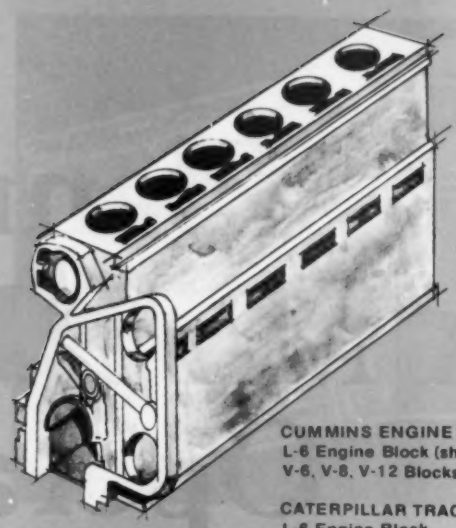
DEERE & COMPANY
V-8 Engine Block (shown)
L-3, L-4, L-6 Blocks

CATERPILLAR TRACTOR CO.
V-8 Engine Block

INTERNATIONAL HARVESTER CO.
V-8 Engine Block

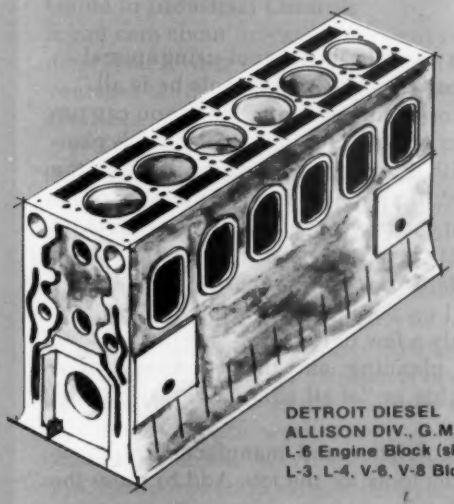


AUTOMOBILES M. BERLIET SA
FRANCE
V-8 Engine Block (shown)
L-6, L-8 Blocks



CUMMINS ENGINE CO.
L-6 Engine Block (shown)
V-6, V-8, V-12 Blocks

CATERPILLAR TRACTOR CO.
L-6 Engine Block



DETROIT DIESEL
ALLISON DIV., G.M.C.
L-6 Engine Block (shown)
L-3, L-4, V-6, V-8 Blocks

ELECTRO-MOTIVE DIV., G.M.C.
V-16 Crank Case (shown)
V-6, V-8, V-12, V-20 Engines

COOPER-BESSEMER CO.
V-16 Crank Case

DRESSER CLARK DIV.
V-20 Crank Case

GENERAL ELECTRIC CO.
V-16 Crank Case

Planning A More Efficient Operation

Thomas Carlyle wrote: "Man is a tool-using animal . . . Without tools he is nothing; with tools he is all."

In planning for manufacturing change you can use all the tools you can get because, at best, such planning is filled with uncertainties and gambles. Will the change work? Will the productivity or quality or reliability be what you have bet on? Will the production workers make it work—or make it fail? Will design changes mandate process or equipment changes which will foul up the ROI?

Those are only a few of the questions that go with manufacturing planning, and the list doesn't even include one as big as "of all alternatives, is this the best one?"

Obviously experience and manufacturing knowledge are the key tools for the job. Add to those the knowledge and experience of others, including the counsel of trusted vendors. And don't forget other information sources.

Here are four more aids to planning. More than 2000 plants are using the Evolution of a Project form to help plan and evaluate capital projects. More than 200 companies use the Deburring Checklist for help with one of manufacturing's most common problems. Readers refer to the Guide to Industrial Controls to help determine the type of control they need for a variety of equipment and operations. And the OSHA checklist helps owners of mechanical power presses determine their compliance with the law.

These aids are available to you as additional tools. Circle the appropriate number(s) on the inquiry card for your own free copies.

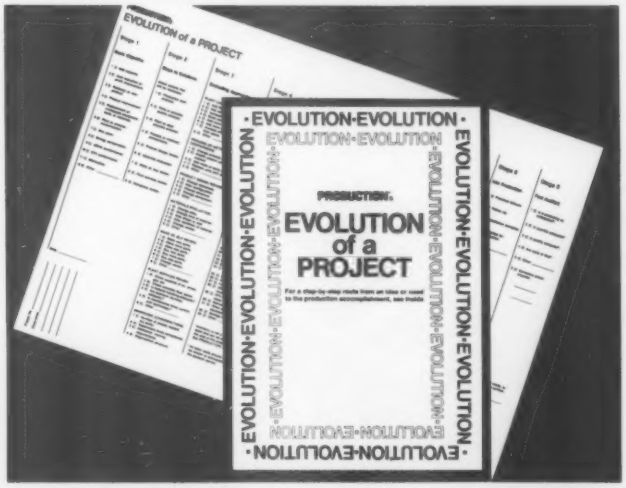
Your Free Guide to Success in Planning

Thousands of manufacturing planners throughout the metalworking industry are using PRODUCTION's *Evolution of a Project*, the ultimate in planning tools. This step-by-step guide takes the planner through every consideration involved in carrying a project from inception to successful completion.

Its nine easy-to-follow stages help you detail a proposal, help you sell a project to management, help you find flaws and avoid errors before it's too late, and give you new confidence in equipment purchase recommendations.

Its lists of reminder items for each stage and orderly organization of successive steps provide a structured means of planning for every contingency that may be involved in any project, large or small.

For your free copy, circle No. *310* on card.

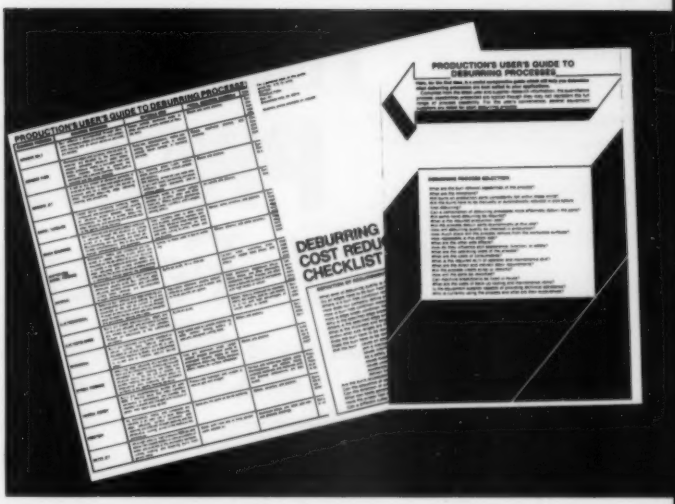


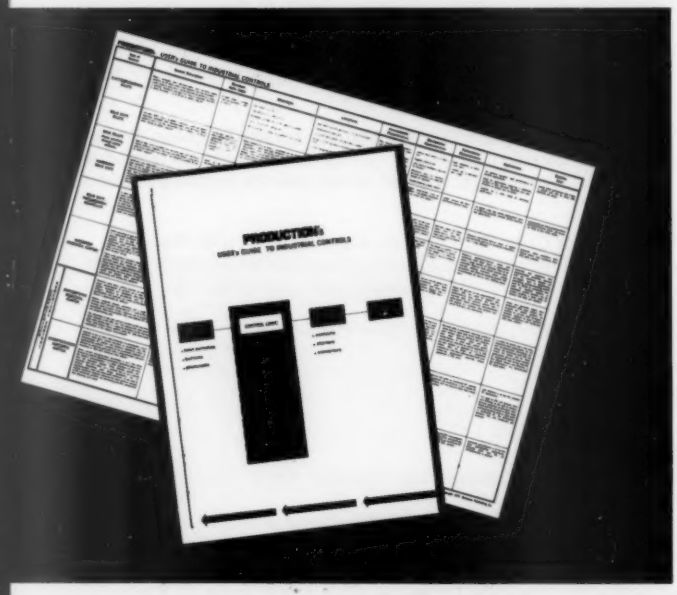
Cures for Deburring Problems

Dristan or NyQuil won't relieve what has been called "The Common Cold of Industry." But PRODUCTION's *User's Guide to Deburring Processes* may help you effect a permanent cure.

This six-page quick reference guide covers 14 different deburring processes, outlines their uses on various materials and part geometries, cites burr removal capabilities, effect on surfaces and lists typical applications. Typical cycle times are given for the different processes, and key suppliers of the various types of equipment used with each process are listed.

The Guide also includes a deburring methods review, a checklist to use in selecting the optimum deburring process, and a deburring cost reduction checklist. Compiled from the latest user and supplier research information, a free copy of this valuable guide may be obtained by circling No. *309* on card.





Guide to Industrial Controls

If you care about operating efficiency of your equipment, you'll want to know the advantages and disadvantages of the different types of industrial controls available.

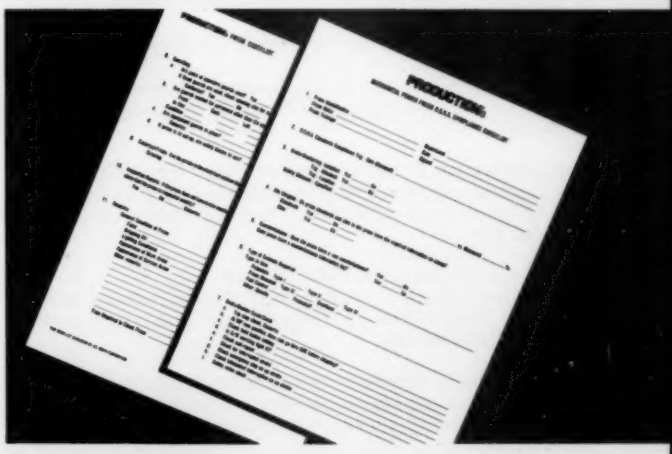
PRODUCTION's *User's Guide to Industrial Controls* provides this information along with descriptions of the seven most common types of controls. Its quick reference format offers information on volt/amp maximums, advantages, limitations, environmental and maintenance characteristics of each type. Also covered are performance characteristics, application recommendations and relative cost data.

Designed for those not intimately involved with the logic portion of industrial controls, the Guide is a valuable reference work covering comparisons of electromechanical relays, solid state relays, reed relays, hardwired solid state, solid state programmable controllers, hardwired NC, minicomputer NC and microprocessor NC. For your free copy, circle No. *308*.

Don't Wait 'til the OSHA Inspector Comes!

Can your press department pass an OSHA inspection tomorrow? If you're not sure that each of your mechanical power presses complies fully with OSHA regulations, PRODUCTION can help.

We've prepared an OSHA compliance checklist which serves as an excellent guide to assure you that your equipment conforms to OSHA regulations. Originally developed by A. O. Smith Corp., the *Mechanical Power Press O.S.H.A. Compliance Checklist* is a practical and proven working tool. For your free copy, circle No. *307* on card.



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MACHINING

NC Machining Cuts Assembly Costs, Too
NC vertical chucker solves critical fit-up problem while reducing both machining time and assembly time. **Circle No. 231**

Mini-Spindles Maximize Contact Production
Production costs are cut in half, tool life is boosted, and new levels of accuracy are attained by equipping machines with electric spindles. **Circle No. 232**

Abrasive Belt Slag Grinder Attacks Production Bottleneck
Abrasive belt slag grinder replaces five manual grinding booths to achieve 40 percent labor savings and significant gain in floor space. **Circle No. 233**

Tool Grind Ups Header Productivity
Seventy-five percent longer die life per grind results when Baker Nail changes to a new grinding wheel. **Circle No. 234**

Plasma-Arc Cutoff Machine Chops Labor 60 Percent
Custom-built machines contour-cut ends of tubing for crane booms and eliminate three operations at Industrial Brownhoist. **Circle No. 235**

Plate Descaling Productivity Up 300 Percent
Self-contained plate descaling system replaces hand grinding resulting in improved quality, faster operations, and reduced costs. **Circle No. 236**

Wire EDM Erodes High Toolmaking Costs
Installation of three wire electrical discharge machines reduced machining time by a factor of four, boosted quality, and substantially cut labor costs. **Circle No. 237**

The Hybrid Rotary . . . New Hi-Production Machining Concept
New machine replaces line of six single-purpose dedicated machines to meet increased production requirements and improve quality. **Circle No. 238**

Close Tolerance Shapers Eliminate Gear Shaving
Gear shaving expenses are avoided as internal ring gears for automatic transmissions are finished in a one-step shaping operation. **Circle No. 239**

Putting the Shrink on Grinding Costs
World's largest power tool manufacturing facility keeps total grinding costs low by heads-up selection of grinding wheels for each specific operation. **Circle No. 240**

Coated-Abrasive Grinding Clears Bottleneck
Increased capacity prompted a change from bonded-abrasive wheel grinding to belt grinding, resulting in reduced labor and material costs. **Circle No. 241**

"We Took Days Out of Our Leadtimes"
Turning/machining center eliminates multiple setups and slashes requirements for work-in-process inventory. Leadtimes cropped from days to hours. **Circle No. 242**

New Tooling Helps Halve Costs
NC machining capabilities are combined with an innovative tooling package to increase efficiency and dramatically cut labor costs. **Circle No. 243**

Hydraulic Oil Care Boosts Uptime on NC Machine Tools
After implementing a hydraulic oil maintenance program tailored to NC machine tools, GE reduced consumption by 25 percent. **Circle No. 244**

Filtration Cuts Grinding Coolant Usage to 80 Percent
Coolant costs on individual grinders are reduced by $2000 annually after installation of special coolant filters. **Circle No. 245**

Abrasive Change Slashes Grind Costs
Wheel life is boosted from about 2000 hard steel parts per wheel to as many as 2 million by a switch in grinding wheels. **Circle No. 246**

FORMING

Robot-Loaded Stamping Presses Keep Pace With Production
The press room at A. O. Smith was made safer and more economical when five robots came on board. **Circle No. 181**

Roll Forming for Profit
Roll forming represents one of the fastest, most highly efficient, and least energy intensive metalworking operations; low labor input required. **Circle No. 182**

Three Problems—One Solution
Cold forming solves three different problems and offers advantages in product design, quantity, quality, and cost requirements. **Circle No. 183**

Why Forge In-House?
"Make or buy" is always a manufacturing consideration. The "make" decision exceeded expectations at Copeland after installing captive forging equipment. **Circle No. 184**

Diecast Housings Drop Costs for Control Maker
A switch to diecasting slashes manufacturing costs 60 to 70 percent, improves product quality, increases productivity, and extends reliability. **Circle No. 185**

Process Change Brings Muscle Plus Precision
A switch from machining to hot forging increases part strength, cuts finished assembly costs, and eliminates one assembly operation. **Circle No. 186**

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FREE LITERATURE

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PRODUCTION
Manufacturing PLANBOOK: 1978

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U.S.A.

New CNC Press . . . The Leading Edge of Perforating Technology
Computer controlled roll feed system on newly designed perforating press slashes changeover costs and strips away conventional methods of perforated plate design. **Circle No. 187**

Powder Metal + Forge = Net Shape
Hot forging of P/M offers significant advantages over conventional machining operations. Material costs are slashed, properties of parts are improved. **Circle No. 188**

Metal Stampers Speak Out on OSHA
Stamping executives discuss their approaches, successes, failures, and huge investments in dealing with problems concerning OSHA regulations. **Circle No. 189**

ASSEMBLY

Line Assembles Four Diesels
European team to produce unconventional automotive diesel engines using flexible equipment operated by "job motivated" employees. **Circle No. 190**

Continuous Electrodes Boost Productivity
Switching from stick welding to continuous wire welding improves weld quality and reduces labor in heat exchanger assembly. **Circle No. 191**

Transfer Machine Doubles Assembly Rate
New assembly tool at Detroit Diesel Allison cuts water pump assembly-and-test cycle times in half while reducing pump-reworks by as much as 60 percent. **Circle No. 192**

Computer Shaves Stamped Assembly Tolerances by 50%
New front suspension on '78 Fords led the way to a marriage between spot welding technology and computer technology—a first in industry and a major breakthrough. **Circle No. 193**

Stitching Plastic to Metal Keys Both Fit and Function
Wire stitching improves appearance and performance of bumper fillers; can be the most advantageous method for assemblies requiring metal reinforcements. **Circle No. 194**

FINISHING

Solvent Switch Boosts Degreasing Performance
A change in solvents at Western Gear resulted in more production between tank cleanings and absence of corrosion on parts in process. **Circle No. 195**

New Car, New Luster
Ford's "better idea" includes a super-luster paint job—first for the domestic auto industry—and first on the new Versailles. **Circle No. 196**

Polishing by the Rack-Full
Electropolishing provides a high quality surface finish on difficult-to-handle and fragile parts economically. In many cases, reliability is improved. **Circle No. 197**

Deburring . . . The Common Cold of Industry
PRODUCTION's Round Table on Deburring . . . User's Guide to Deburring Processes . . . Deburring Cost Reduction Checklist . . . the newest innovations in deburring. **Circle No. 198**

One-Step Process Cuts Satin-Finish Plating Costs
Velours nickel process provides economical one-step plated satin finishes; replaces conventional process and slashes manufacturing costs up to 50%. **Circle No. 199**

Vacuum Carburizing Is a Commercial Success
Vacuum heat treat furnace leads to shorter cycle times, elimination of safety problems with heat treating, lower operating costs for Texas manufacturer. **Circle No. 200**

PERISHABLE CUTTING TOOLS

Perishable Tooling Keeps Energy Pipeline Full
Johnston Division sets up a machining operation geared to producing more than 500 different styles of oil field tools to aerospace-type tolerances. **Circle No. 201**

Boosting Uptime No Secret
Modular fixtures and standarized cutting tools for NC machines convert low volume production into highly efficient manufacturing operations at FMC. **Circle No. 202**

CONTROLS

DNC: Tomorrow's Ultimate Standard Control?
Although lack of application has tarnished the reputation of direct numerical control, users praise its performance and believe widespread acceptance is inevitable. **Circle No. 203.**

Press Monitoring System Boosts Productivity
An on-line computer system monitors more than 120 production presses while upgrading press shop efficiency and reducing machine maintenance time. **Circle No. 204**

Fresh Thinking on NC: Why It Succeeds or Fails
NC reduces manufacturing costs and increases productivity in a job shop environment. An analysis nails down what's behind resistance to NC. **Circle No. 205**

One Chucking Does It All
NC proved to be the most economical production method for high volume job. Two NC turning machines turn out large volumes of parts at substantial savings. **Circle No. 206**

Shop Floor Controls Slash Work-in-Process Inventory
Data collection system reduces in-process inventory by $2 million, increases production efficiency, cuts costs, and balances activities on the shop floor. **Circle No. 207**

MATERIALS HANDLING

A Change in Material . . . A Reduction in Scrap
Scrap loss is cut from five percent to under one percent by coordinating the design of tooling and equipment used for three-stage drawing operations. **Circle No. 208**

Pre-Turned Bars Trim Costs—Four Ways
A switch from cold drawn to pre-turned hot rolled bar lowers material costs, simplifies processing, improves quality, in the manufacture of piston pins. **Circle No. 209**

Can Detroit Win at Materials Bingo?
An examination of materials changes within the automotive industry and the effect they will have on manufacturing practices for both users and suppliers. **Circle No. 210**

Materials Changes Force Production Breakthroughs
Mandatory weight reductions for automobiles dictate material and manufacturing process changes. Diecasting machine improvements help get the weight out. **Circle No. 211**

GENERAL MANUFACTURING

Curing High Technology Phobia
The fear of failure scares off many potential users of advanced manufacturing processes. But GM's Diesel Equipment developed its own cure for this malady. **Circle No. 212**

Shifting to Make Smaller Cars Accelerates Process Tune-Ups
Automakers find shift to production of smaller cars presents opportunities to improve production operations. **Circle No. 213**

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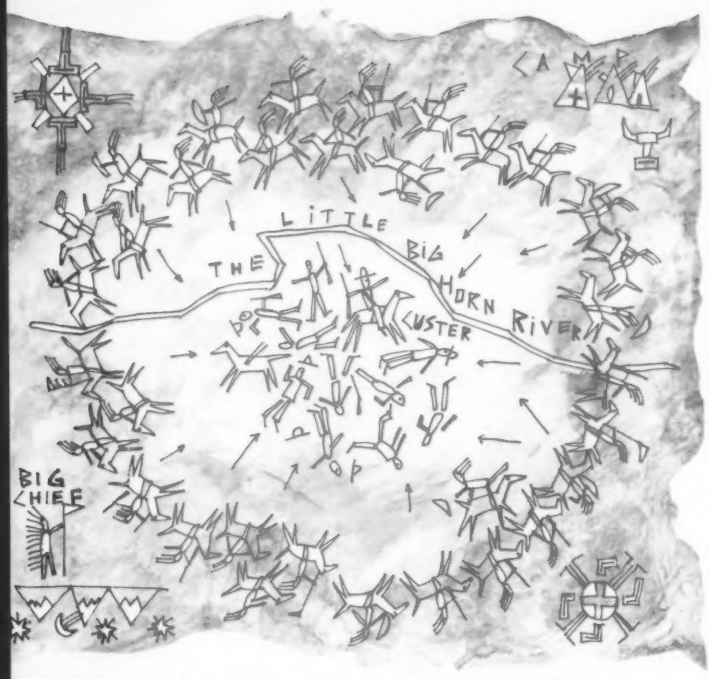

On June 25, 1876, George Armstrong Custer ignored his scouts' warnings of many Indians gathered at Little Big Horn. So he rode out with 250 men to "surround" 6,000 Indians. This was a serious error.

Numbers can make all the difference.

It is always a serious error to ignore numbers or talk about them in vague terms. BPA (Business Publication Audit of Circulation, Inc.) guarantees the circulation figures of our member magazines — issue after issue. When you advertise in BPA-audited magazines, you get precise, nonpromotional numbers.

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(continued)

Teams Gang Up On Manufacturing Costs
First year savings of $600,000 result when Rotron reviews 12 basic product lines. Eventual annual gain could top $1 million. **Circle No. 214**

Industry's Ailing Image—A Self-Diagnosis
Three top executives candidly discuss issues fundamental to industry's ability to raise the $4.5 billion needed to achieve productivity breakthroughs. **Circle No. 216**

Industry's Ailing Image—Part II
A scholar and two U.S. Senators express their views on fundamental issues industry must face and examine the public's lack of confidence in business. **Circle No. 217**

Industry's Ailing Image—Part III . . . A Positive Prognosis
Here are some of the steps which can be taken to alleviate the problems industry has with government, labor, and the public. **Circle No. 218**

Helping Customers Helps Job Shop
Contract stamper helps customers with redesigns and large-scale mutual benefits abound. Customer service is their main forte. **Circle No. 219**

Productivity: Where to Find It
Phoenix-area manufacturers discuss increased productivity and how it was achieved. All cite examples of their accomplishments. **Circle No. 220**

Needed: Breakthroughs in Manufacturing Technologies
A spokesman for Cooper Energy Services tells what his company needs to make significant gains in productivity, cost, quality, and manufacturing efficiency. **Circle No. 221**

When A Part Can't Be Purchased, Make It—Better
Innovative process change reduces costs, improves quality, slashes inventory, cuts lead time, solves availability problem. **Circle No. 222**

Bell Helicopter Textron Seeks Machining Innovations
Bell's $39 million Machining Center challenges machine tool builders to develop innovations in gearmaking, inspection equipment, and deburring technology. **Circle No. 223**

Where To Look for Productivity Boosts
Seven manufacturing men from the Minneapolis area tell how they get more output from existing equipment and increase plant productivity. **Circle No. 224**

"We've Jumped Productivity Overall by 45%"
System of job definition and description has led to higher profits for the company, greater benefits for employees, and productivity boosts of up to 75 percent. **Circle No. 225**

Manufacturing: Where A Design Must Pay Off
Manufacturing executives from the Cleveland area point out the value, necessity, and benefits of a teamwork effort between product and manufacturing engineers. **Circle No. 226**

New Concepts Span High-Low Volume Gap
Dreams of mid-volume manufacturers are being answered by equipment builders. Operations are more productive, more cost effective, and more profitable. **Circle No. 227**

How Much Inventory Should You Have?
Westinghouse has devised a simple method to determine inventory optimums. The result is six-figure savings with no sacrifice in quality, efficiency, or delivery. **Circle No. 228**

Are Machine Tool Buyers Seeking Guaranteed Uptime?
European manufacturers routinely ask machine tool builders to guarantee new machine tool performance. American companies begin to seek similar assurances. **Circle No. 229**

Computer Techniques Isolate Production Snags
Computer simulation—one of the more useful tools for evaluating what a machine tool or sequence of machine tools will accomplish when installed. **Circle No. 230**

Capital Spending:

Up 4.6% in 1978 -- On Top of a Good 1977

Cost reduction programs instituted during the last 30 months continue to pay off in improved earnings and cash flow in a period of only modestly improved operating ratios

Production metalworking industries* will spend about $6.43 billion this year for machinery and equipment. These figures, obtained from an annual survey conducted by Bramson Publishing Co.'s Research Div. are for use in PRODUCTION and in the Manufacturing PLANBOOK. Much of this improvement is based on the fact that 56.4 percent of the respondents indicated they expect to increase spending above 1977 levels. Last year 56.9 percent said they expected to increase capital spending.

Survey Highlights. Major points registered in the survey show:

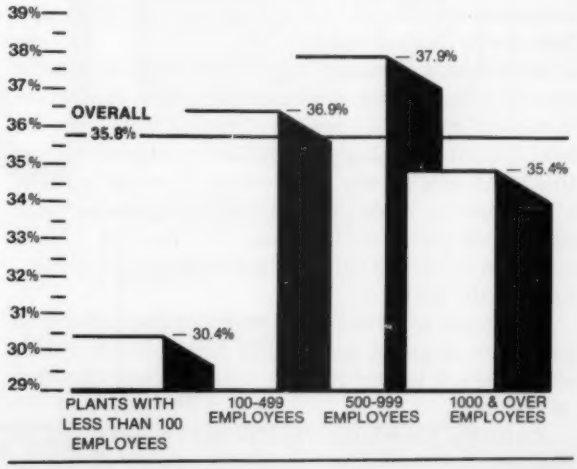
- Cost reduction continues to be the main reason for machinery and equipment expenditures; it is ranked most important by 45 percent of the respondents, a 3 percent decline from last year's figure.
- The average minimum first year return-on-investment (pre-tax) in justifying new production equipment is 35.8 percent, up only 0.1 percent from the figure a year ago. In plants employing 100-999, a higher justification figure is required; in plants employing 1000 or more a slightly lower figure, 35.4 percent, is required.
- Numerically controlled machines will be bought in 1978 at a higher rate, 36.3 percent of respondents in 1978, compared with last year's 34.4 percent. Of those plants intending to buy, 85.8 percent already use NC machines.
- An increasing number of plants—up 5 percent over 1977 to 37 percent—cite an increase in capacity as their primary spending objective. This reflects an improvement in the respondents' operating rate relative to capacity at 78.3 percent compared with 76.1 percent a year ago and 73.2 percent two years ago. Large plants (1000 or more employees) are faring better and operate as a group at 78.9 percent with more than half of these larger plants operating above an 81 percent utilization rate on a two-shift basis.

Spending Goals. The manufacturers planning to increase their capital spending in 1978 said their primary motivations are: need for new machines to reduce cost, 70.5 percent vs. 67.2 percent in 1977; need to increase capacity, 64.7 percent; need to produce more good parts to present or tighter specifications, 32.7 percent; need to bring new operations into the plant for parts/services formerly purchased from outside vendors, 32.7 percent, up from 28.3 percent last year; and the need to provide additional pollution control and safety equipment, 16.3 percent, down from 19.0 percent in 1977.

The respondents who will reduce spending in 1978, up 1.2 percent to 14.4 percent, cited these reasons: machine capacity adequate, 60.8 percent vs. 50.7 percent last year; decline in sales, 26.1 percent; profit decline, 15.6 percent. The 9.5 percent reporting that machine capacities exceed needs compares with 16.3 percent in 1977.

Digging a little deeper into the spending motives of all responding plants, the survey shows the following

FIRST YEAR RETURN ON INVESTMENT (PRE-TAX)



*Considered for the purpose of this survey to be plants reached by PRODUCTION Magazine in Fabricated Metal Products (SIC 34); Machinery, except Electrical (SIC 35); Electrical Machinery (SIC 36); Transportation Equipment (SIC 37); and Instruments (SIC 38).

1978 figures are projected from respondents from 7000 plants contacted in the survey last September-October, in keeping with past procedures.

major avenues used to optimize cost-quality-capacity:

- Rearranging operations to shorten supply lives, reduce materials handling, and cut in-process inventory, 55.0 percent, with heavier emphasis reported by plants in the East North Central, West North Central, East South Central, and Mountain regions.
- Adopting processes-machines-materials that minimize process requirements, 47.2 percent, with plants in the New England, South Atlantic, and Mountain regions paying more than average attention to opportunities afforded by this approach.
- Setting up or planning to set up computerized production control, 39.8 percent, with greater than average emphasis being reported by plants in New England, Mid-Atlantic, West North Central, and South Atlantic states.
- Performing more operations in-plant than previously had been done outside, 38.1 percent, with more of that being done in the West North Central and Mountain regions and less in the Mid-Atlantic and East North Central regions.
- Establishing separate production areas to handle special or low volume jobs, service parts, special orders , and so on, 28.2 percent. Respondents from the Mid-Atlantic and East South Central regions report this trend to a greater degree than do other regions.
- Purchasing from outside vendors parts/services previously produced in-house, 17.9 percent. This is common in New England, Mid-Atlantic, Mountain, and Pacific plants.

Reduction of direct labor remains the major cost reduction target of responding plants and has been since 1971. It is cited by 79.5 percent, about the same as last year.

Reducing materials costs continues to be a target for concentrated attention, with 58.3 percent of the responding plants, up from 56.9 percent, listing it as a major objective. Reducing assembly costs, 47.2 percent, reduction of in-process inventory, 39.3 percent, and materials handling costs, 35.7 percent, also are cited by responding plants as major 1978 objectives.

How the Money Will Be Spent. As has been the case in the last 13 surveys, metalcutting machine tools will capture the largest share, 30.6 percent, of the 1978 capital equipment dollar, a 5.3 percent decline from last year. That amounts to $1.96 billion, which roughly equals the metalcutting machine tool industry's 1977 domestic shipments to metalworking plants. This new business will maintain the present level of the machine tool builders' backlog which means you should plan on an *unimproved* delivery situation in 1978-79.

Assembly machinery and equipment will be the second largest item in the investment budget at 15.6 percent, or $1.0 billion. Metal forming equipment at 13.8 percent and $833 million will be next. Materials handling equipment will account for 7.5 cents of the capital investment dollar; cleaning and applied finish equipment, 6.1 cents; gaging-inspection-testing equipment, 5.6 cents; welding-riveting-brazing equipment, 5.4 cents; plastic molding and forming equipment, 2.7 cents; and heat treat equipment, 2.5 cents, up 50 percent from 1977 because of the need for energy effective equipment.

NC Spending Plans. Numerically controlled equipment purchases will grow both in units and dollar value in 1978 with 36.3 percent of the responding plants, up 1.9 percent from 1977, planning to buy NC equipment in 1978. An additional 12.4 percent are planning to purchase NC equipment within 12 to 24 months, but not in 1978.

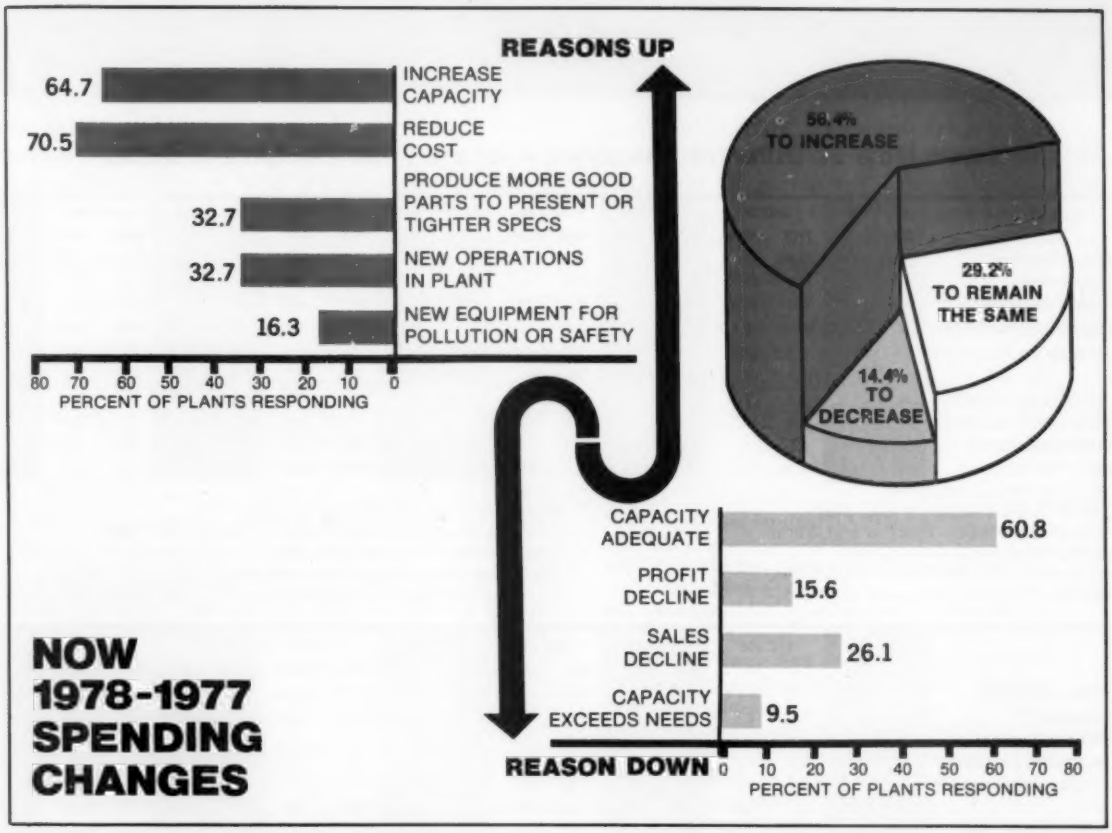
Of the respondents reporting plans to purchase NC equipment in 1978, 71.3 percent are located in the following regions: East North Central, 34.3 percent; Mid-Atlantic, 16.1 percent; New England, 11.0 percent; and the Pacific, 9.9 percent.

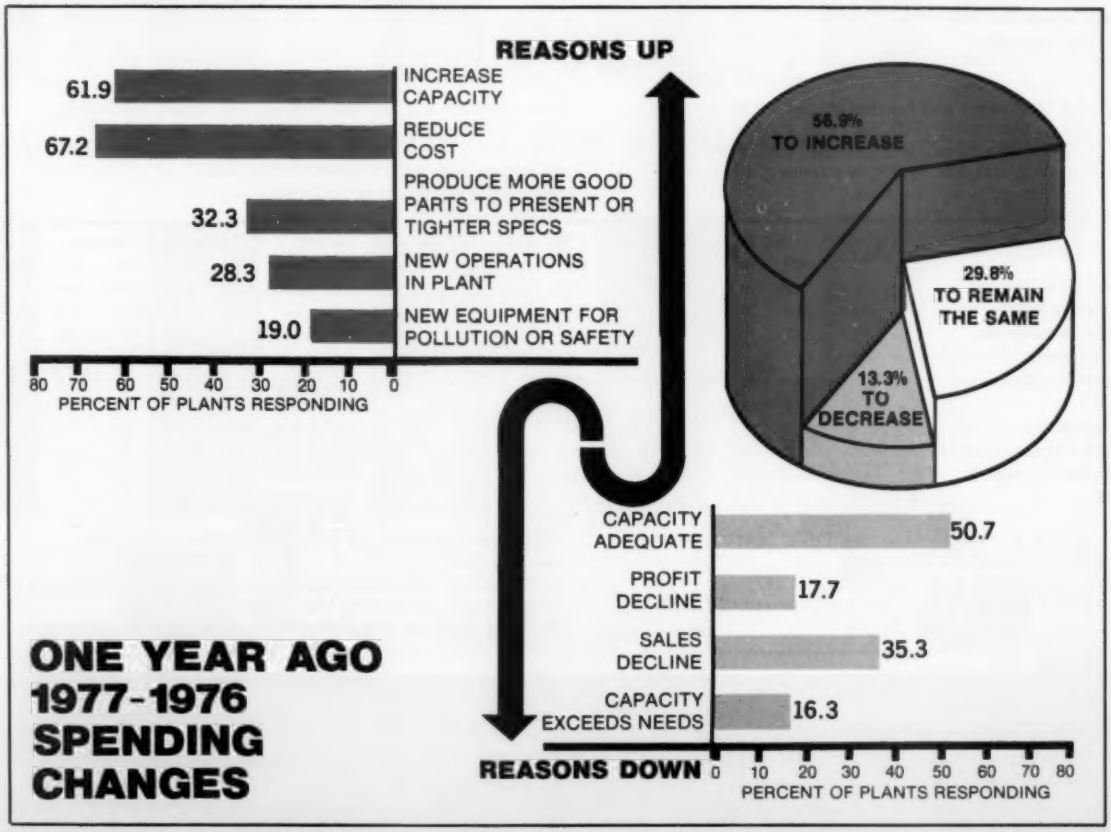
As has been shown in the last seven surveys, most of the plants intending NC purchases already are NC users. The existing NC user market should account for 80-85 percent of the 1978 orders placed for new NC machines. Although the growth of NC machine use as measured in units has been nominal, NC did account for about 30 percent of the dollar value of all machine tool purchases in 1977. Over the last five surveys, plants reporting NC use has grown by 50 percent:

Percent of Responding Plants Operating NC

1974	1975	1976	1977	1978
32.1%	40.7%	43.0%	45.5%	47.1%

Those respondents reporting that their plants operate NC machines, 47.1 percent, operate an average of 7.7 NC machines per plant and account for 11.1 percent of all NC machines installed in the United States since 1955. About 65.6 percent of these plants now


REASONS UP
64.7
INCREASE CAPACITY
70.5
REDUCE COST
32.7
PRODUCE MORE GOOD PARTS TO PRESENT OR TIGHTER SPECS
32.7
NEW OPERATIONS IN PLANT
16.3
NEW EQUIPMENT FOR POLLUTION OR SAFETY
80 70 60 50 40 30 20 10 0
PERCENT OF PLANTS RESPONDING
56.4% TO INCREASE
29.2% TO REMAIN THE SAME
14.4% TO DECREASE
CAPACITY ADEQUATE
60.8
PROFIT DECLINE
15.6
SALES DECLINE
26.1
CAPACITY EXCEEDS NEEDS
9.5
REASON DOWN
0 10 20 30 40 50 60 70 80
PERCENT OF PLANTS RESPONDING
NOW
1978-1977
SPENDING
CHANGES


REASONS UP
61.9
INCREASE CAPACITY
67.2
REDUCE COST
32.3
PRODUCE MORE GOOD PARTS TO PRESENT OR TIGHTER SPECS
28.3
NEW OPERATIONS IN PLANT
19.0
NEW EQUIPMENT FOR POLLUTION OR SAFETY
80 70 60 50 40 30 20 10 0
PERCENT OF PLANTS RESPONDING
56.9% TO INCREASE
29.8% TO REMAIN THE SAME
13.3% TO DECREASE
CAPACITY ADEQUATE
50.7
PROFIT DECLINE
17.7
SALES DECLINE
35.3
CAPACITY EXCEEDS NEEDS
16.3
REASONS DOWN
0 10 20 30 40 50 60 70 80
PERCENT OF PLANTS RESPONDING
ONE YEAR AGO
1977-1976
SPENDING
CHANGES

Here's How 27 Different Industries Allocate Their Equipment Dollar

	SIC 342		SIC 343		SIC 344		SIC 345		SIC 346		SIC 349		SIC 351		SIC 352		SIC 353	
	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977
METALCUTTING MACHINES	14.4%	17.5%	22.6%	15.3%	9.7%	12.9%	33.0%	56.5%	14.0%	17.3%	31.7%	30.3%	60.3%	60.6%	31.4%	29.0%	45.4%	48.5%
ASSEMBLY EQUIPMENT	14.2	15.5	12.0	11.4	14.3	9.4	12.4	9.8	9.6	10.8	12.0	9.6	4.4	6.0	4.8	6.9	6.2	5.3
METALFORMING MACHINES	26.5	13.1	18.5	27.7	19.7	21.4	11.9	7.1	36.2	36.7	15.1	18.7	5.4	6.3	20.0	25.3	9.8	10.8
MATERIAL HANDLING EQUIPMENT	8.0	6.1	10.7	12.7	14.3	17.3	11.9	4.8	7.2	10.2	8.5	7.0	5.6	6.0	8.4	7.2	10.1	9.4
CLEANING/FINISHING EQUIPMENT	8.4	12.7	9.6	5.0	7.5	10.0	6.6	3.8	8.2	4.5	4.9	5.4	1.9	4.5	9.2	6.0	6.4	4.3
WELDING	5.6	4.6	7.5	7.3	16.6	17.7	1.5	—	4.6	3.4	5.6	7.7	6.6	3.5	7.0	5.5	7.5	10.4
GAGING/INSPECTION/TESTING	2.9	5.0	2.3	2.1	2.0	3.0	3.6	3.9	2.0	5.7	3.1	3.9	5.6	4.5	3.1	3.9	3.0	3.3
PLASTIC MOLD-FORM EQUIPMENT	4.9	9.7	1.8	4.5	1.5	0.4	1.5	0.4	4.0	2.1	1.4	2.3	—	1.0	0.4	0.1	0.7	—
HEAT TREATING EQUIPMENT	4.9	4.9	0.5	—	0.8	1.3	3.1	2.4	2.8	2.0	4.9	2.2	1.0	2.4	3.1	2.8	4.1	3.2
ALL OTHER	9.4	10.9	14.0	14.0	13.1	8.6	14.0	11.3	8.9	7.3	12.3	12.9	8.7	5.2	12.1	13.3	6.3	4.8

Cutlery, Hand Tools, Hardware (SIC 342)
Heating Equipment, Except Electric and Warm Air; and Plumbing Fixtures (SIC 343)
Fabricated Structural Metal Products (SIC 344)
Screw Machine Products, Fasteners (SIC 345)
Metal Forgings and Stampings (SIC 346)
Miscellaneous Fabricated Metal Products (SIC 349)
Engines and Turbines (SIC 351)
Farm and Garden Machinery and Equipment (SIC 352)
Construction, Mining and Materials Handling Equipment (SIC 353)

	SIC 354		SIC 355		SIC 356		SIC 357		SIC 358		SIC 359		SIC 361		SIC 362		SIC 363	
	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977
METALCUTTING MACHINES	63.6%	62.9%	52.0%	59.8%	47.6%	53.2%	16.3%	14.7%	22.9%	15.9%	51.3%	61.9%	12.2%	14.4%	23.3%	25.1%	9.6%	6.7%
ASSEMBLY EQUIPMENT	4.6	5.7	7.5	2.7	10.2	8.7	31.2	32.0	14.2	14.3	3.6	5.1	24.5	28.6	19.5	21.2	21.9	16.9
METALFORMING MACHINES	6.1	10.0	10.8	7.9	7.8	10.5	10.5	10.4	28.2	31.5	7.7	9.7	16.2	11.9	13.7	12.5	19.1	30.1
MATERIAL HANDLING EQUIPMENT	4.6	2.7	8.0	6.2	8.3	6.3	4.8	4.6	7.7	6.2	5.8	4.1	4.5	7.1	7.5	6.9	9.5	9.1
CLEANING/FINISHING EQUIPMENT	1.8	1.1	3.1	0.9	3.7	3.5	7.3	3.8	7.4	5.4	5.0	2.3	9.6	5.3	10.1	4.7	8.3	5.9
WELDING	1.0	1.6	4.2	6.2	5.6	3.0	1.3	2.9	5.5	9.6	5.3	1.9	4.3	5.7	2.8	3.5	5.9	8.6
GAGING/INSPECTION/TESTING	6.6	4.1	3.1	4.4	5.4	4.9	14.6	12.4	2.0	4.2	6.2	5.5	9.9	5.4	6.4	4.1	5.4	3.7
PLASTIC MOLD-FORM EQUIPMENT	1.4	3.9	0.4	1.5	0.7	0.2	5.4	2.7	2.7	8.8	2.2	0.9	2.6	5.3	0.9	5.6	6.6	9.2
HEAT TREATING EQUIPMENT	1.8	1.2	2.7	0.6	3.6	2.9	—	1.2	1.7	—	4.2	1.5	0.4	0.5	1.3	0.6	3.5	0.1
ALL OTHER	7.7	6.6	7.8	9.8	8.5	6.8	8.1	15.3	7.3	4.1	8.1	7.1	15.0	15.8	14.1	15.8	7.8	9.7

Metalworking Machinery and Equipment (SIC 354)
Special Industry Machinery (SIC 355)
General Industrial Machinery & Equipment (SIC 356)
Office, Computing and Accounting Machines (SIC 357)
Refrigeration and Service Industry Machinery (SIC 358)
Miscellaneous Machinery, Except Electrical (SIC 359)
Electrical Transmission and Distribution Equipment (SIC 361)
Electrical Industrial Apparatus (SIC 362)
Household Appliances (SIC 363)

	SIC 364		SIC 366		SIC 367		SIC 369		SIC 371		SIC 372		SIC 381		SIC 382		SIC 384	
	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978	1977
METALCUTTING MACHINES	17.2%	13.6%	19.9%	19.1%	11.1%	11.1%	14.6%	8.9%	31.9%	28.2%	49.1%	55.2%	30.5%	21.3%	31.6%	28.4%	23.6%	25.2%
ASSEMBLY EQUIPMENT	30.3	22.1	28.4	20.5	33.0	32.2	41.2	41.5	15.1	18.5	3.1	7.4	14.0	30.9	23.8	25.5	18.0	20.5
METALFORMING MACHINES	13.3	24.9	9.2	10.3	7.1	4.9	4.0	12.7	15.4	16.6	9.0	7.2	12.7	6.3	6.1	6.3	11.4	7.7
MATERIAL HANDLING EQUIPMENT	5.3	8.0	6.7	3.9	3.0	4.9	6.9	6.5	8.9	9.6	5.4	1.8	4.1	6.3	4.6	4.6	5.4	9.5
CLEANING/FINISHING EQUIPMENT	2.0	7.4	5.7	5.7	7.4	8.8	3.0	5.3	6.6	5.6	3.9	3.5	11.7	4.7	5.1	4.7	8.4	3.5
WELDING	3.2	2.2	3.5	2.5	2.2	1.9	1.2	2.4	6.3	6.0	6.3	3.6	2.3	2.8	6.0	4.0	4.0	4.8
GAGING/INSPECTION/TESTING	4.0	2.8	13.9	15.8	10.4	9.2	8.4	4.8	3.1	4.6	5.9	8.3	16.9	7.9	5.8	7.0	5.1	13.9
PLASTIC MOLD-FORM EQUIPMENT	9.3	7.6	2.2	4.0	4.5	7.9	7.5	7.7	1.2	1.5	1.0	1.3	1.1	0.8	5.7	5.1	15.3	4.4
HEAT TREATING EQUIPMENT	1.2	0.3	0.8	0.9	1.5	2.5	0.4	0.7	2.8	2.7	6.5	3.5	0.3	0.7	2.5	3.3	1.3	—
ALL OTHER	13.8	11.1	9.2	17.3	19.3	16.6	12.2	9.5	8.1	8.7	9.2	8.2	4.0	18.3	6.3	11.5	9.1	10.5

Electric Lighting and Wiring Equipment (SIC 364)
Communication Equipment (SIC 366)
Electronic Components & Accessories (SIC 367)
Miscellaneous Electrical Machinery & Equipment (SIC 369)
Motor Vehicles & Motor Vehicle Equipment (SIC 371)
Aircraft and Parts (SIC 372)
Engineering, Laboratory, Scientific & Research Instruments (SIC 381)
Measuring & Controlling Instruments (SIC 382)
Surgical, Medical, and Dental Instruments and Supplies (SIC 384)

operating NC machines plan to purchase more NC equipment; is a medium-sized to large plant, 91.9 per- plan to purchase within the next 12 to 24 months. The remaining 16.7 percent of NC using plants do not plan, as of October 1977, to purchase NC in the next two years.

The typical NC user, who is expanding the use of NC in 1978: is operating at 79.7 percent of capacity compared with the all-plant average of 78.3 percent; will spend $995,941 in 1978 for production machinery and equipment, up from $916,456 in 1977; allocates 52.5 percent of its capital investment to metal-cutting machines and 9.4 percent to metal forming equipment; is a medium-sized to large plant, 91.9 percent employ more than 100 persons; and will be buying more than one type of NC equipment.

The typical first-time purchaser of NC in 1978, on the other hand, can be described as: operating at 77.1 percent of capacity; spending $628,929 in 1978 for machinery and equipment; allocating 30.4 percent of investment capital to metalcutting machines and 17.2 percent to metal forming equipment; being a medium-sized to large plant, 80.0 percent of the plants responding employ 100 or more; and inclined to buy more than one type of NC equipment in 1978.

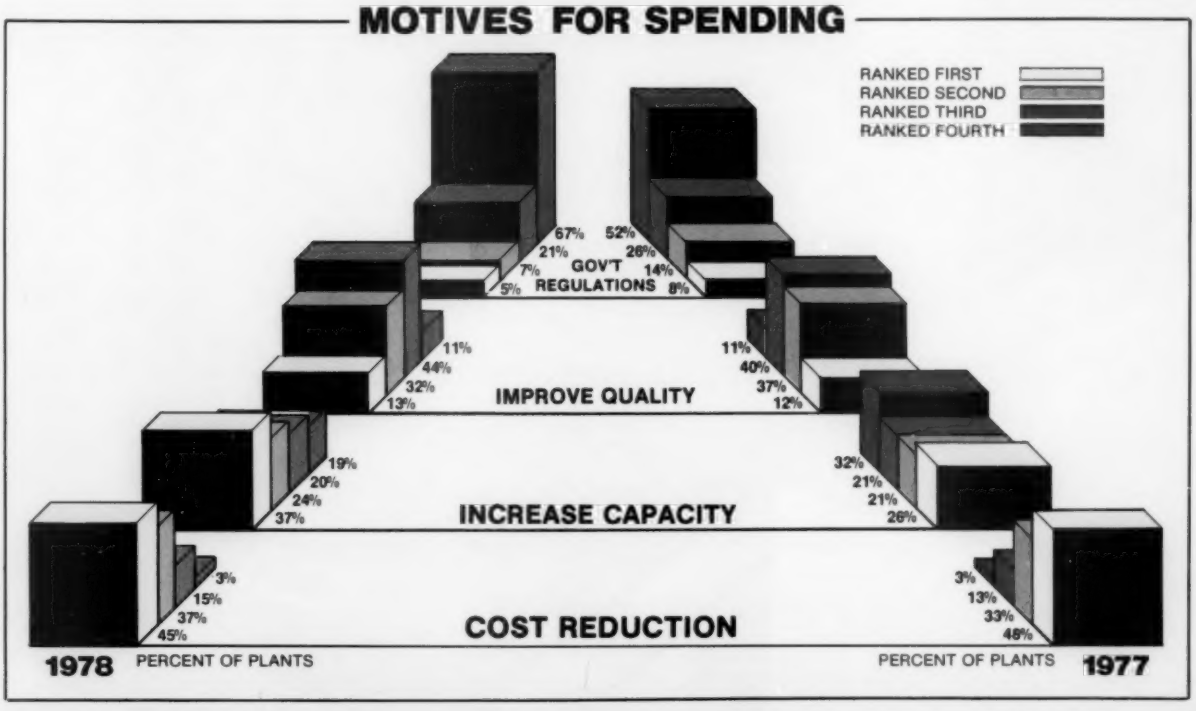
The types of NC equipment to be purchased are indicated by these percentages relating the equipment type to the plants which plan NC purchases in 1978: turning equipment, 41.2 percent; horizontal machining centers, 35.5 percent, up from 32.3 percent in 1977 and 27.7 percent in 1976; vertical machining centers, 27.5 percent, unchanged from one year ago; drilling machines, 22.9 percent; milling machines, 21.5 percent; punching machines, 14.7 percent, up from 13.2 percent in 1977 and 11.7 percent in 1976; boring machines, 13.9 percent, up from 11.7 percent last year; profiling machines, 7.4 percent; and bending machines, 3.9 percent.

Computer Controlled Production Equipment. It's Growing! Of the survey's respondents, 25 percent report use of computers and minicomputers to control production equipment. That figure is up from 19.7 percent a year ago, 17.3 percent two years ago, and 13.2 percent in our 1975 forecast. Another 10.4 percent plan purchases in the next 18 to 24 months. While all reporting industries report computer-controlled production equpment installations, 75 percent of the use is centered in the following:

SIC	Industry	Percent of Total Respondents Operating Computer-Controlled Equipment
344	Fabricated Structural Metal Products	3.5
346	Metal Forgings and Stampings	4.1
353	Construction, Mining and Materials Handling Equipment	3.5
354	Metalworking Machinery and Equipment	6.4
356	General Industrial Machinery and Equipment	4.4
357	Office, Computing and Accounting Machines	5.6
358	Refrigeration and Service Industry Machinery	2.9
359	Miscellaneous Machinery, except Electrical	2.6
361	Electrical Transmission and Distribution Equipment	3.5
362	Electrical Industrial Apparatus	3.8
363	Household Appliances	2.3
366	Communications Equipment	9.1
367	Electronic Components and Accessories	10.8
371	Motor Vehicles, Motor Vehicle Equipment	5.8
372	Aircraft and Parts	4.4
381	Engineering, Laboratory, Scientific & Research Instruments	2.3

(continued on page 29)

MOTIVES FOR SPENDING



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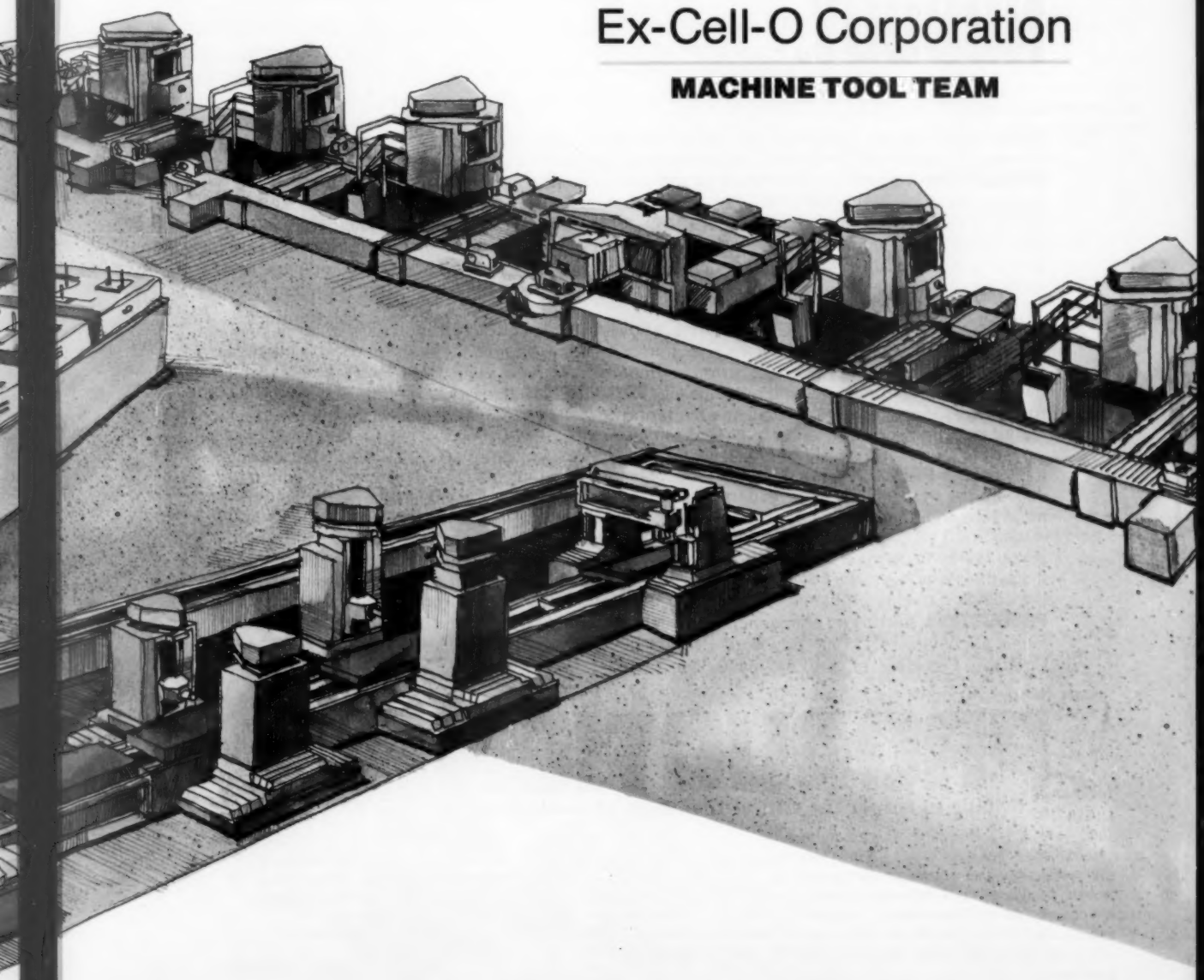
Ex-Cell-O Corporation

MACHINE TOOL TEAM



CIRCLE NO. 7 ON READER INQUIRY CARD

NOBODY INFLUENCES THE MANUFACTURING TEAM AS EFFECTIVELY AS PRODUCTION.

NOBODY.

Some magazines are published for specific functions, such as plant engineering or purchasing. Others are published for specific industries, such as automotive, aircraft or electronics. **PRODUCTION**, however, is published for the manufacturing generalist in the hundreds of metalworking industries, some of which are listed below. This reader may be a manufacturing manager who is charged with the responsibility for the day-to-day operations of his plant. Or he may be the manufacturing engineer who works hand-in-hand *with* the manufacturing manager, and who is charged with the primary responsibility for selecting the processes, equipment, and materials which will achieve the most *profitable* manufacturing operation for his company.

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PROJECTED 1978 CAPITAL EQUIPMENT INVESTMENT

By Equipment Type and Plant Size

	PERCENTAGES					
	50-99 Employees	100-499 Employees	500-999 Employees	1000+ Employees	Total $ Millions*	1978 vs 1977 % Change
METAL CUTTING	31.9%	28.2%	30.1%	33.3%	$1,966.3	- 3.8%
ASSEMBLY	11.7	16.7	17.2	14.8	1,001.3	+ 9.1
METAL FORMING	16.9	14.6	12.3	9.6	832.7	+ 3.2
MATERIAL HANDLING	6.8	8.1	7.9	6.6	476.5	+11.7
GAGING/INSPECTION/TESTING	5.0	4.8	5.7	7.8	379.8	+10
FINISHING	5.9	6.4	5.9	6.7	407.3	+28.1
WELD/RIVET/BRAZE	6.7	6.1	4.6	4.6	350.0	+16.0
PLASTIC MOLDING	2.4	2.5	3.9	2.3	172.7	-13.4
HEAT TREATING	3.1	2.1	3.3	2.5	165.4	+42.9
OTHER	9.2	10.5	9.1	11.8	673.4	+ 1.3
					$6,427.4	+ 4.6%

*1977 dollars

Location by plant size of computer-controlled production equipment installations is indicated in the survey as follows: 8.7 percent in plants employing 50-99; 31.5 percent in plants employing 100-499; 24.6 percent in plants employing 500-999; and 35.3 percent in plants employing 1000 or more. Plant size of those responding that they intend to purchase computer-controlled production equipment within 12 to 24 months is as follows: 11.9 percent in plants employing 50-99; 34.0 percent in plants employing 100-499; 32.6 percent in plants employing 500-999; and 21.5 percent in plants employing 1000 or more.

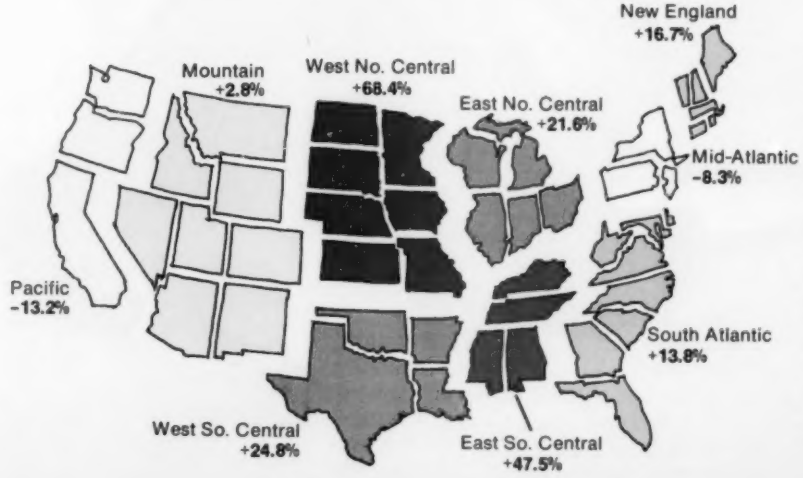
Assembly Equipment. High rates of return on investment and reduction of direct labor costs have influenced assembly investment dramatically over the last few years. Respondents report that investment in assembly equipment will climb 9.1 percent in 1978 to $1.001 billion. Of this amount, $165 million will be spent on semiautomatic or automatic assembly machines which will be supplied by both outside vendors and in-house design and build groups. This will include assembly function equipment integrated into metalcutting transfer lines and the like.

Most assembly equipment installations will occur in 14 industry groups which include:

SIC	Industry	Percent of Total Capital Expenditures for Assembly Machines-Equipment
342	Cutlery, Hand Tools & General Hardware	14.3
348	Ordnance and Accessories, exc. Vehicles & Guided Missiles	23.7
357	Office, Computing and Accounting Machines	31.2
361	Electrical Transmission and Distribution Equipment	24.5
362	Electrical Industrial Apparatus	19.5
363	Household Appliances	21.9
364	Electric Lighting and Wiring Equipment	30.3
366	Communication Equipment	28.4
367	Electronic Components & Accessories	33.0
369	Miscellaneous Electrical Machinery, Equipment & Supplies, nec	41.3
371	Motor Vehicles, Motor Vehicle Equipment	15.2
382	Measuring and Controlling Instruments	23.8
384	Surgical, Dental & Medical Instruments & Supplies	18.0
386	Photographic Equipment & Supplies	25.6

About 90 percent of all assembly investment projected for 1978 will be made by plants employing 100

(continued on page 33)



Respondents to PRODUCTION's 1978 Capital Spending Forecast survey indicate that, on the average, they will spend 4.6% more for capital equipment this year than they did in 1977. But the respondents from different regions of the country had varying degrees of optimism about this year.

In the West North Central states, for example, respondents indicate a spending increase of 7.7% this year over 1977; that boost is 68.4% greater than the national average. Respondents from the Pacific Coast states, though, indicate they'll spend 4% more this year than last—13.2% under the national increase. Significantly, no region indicates reduced spending in 1978.

One reason why you need a positioner.

It'll save you money.
Positioners can reduce welding labor, overhead and materials handling costs by 40% or more, and improve weld quality. Easily and safely. So your investment (average $8,000) can be returned in less than a year.

CIRCLE NO. 8 ON READER INQUIRY CARD

Seven reasons why you need an Aronson positioner.

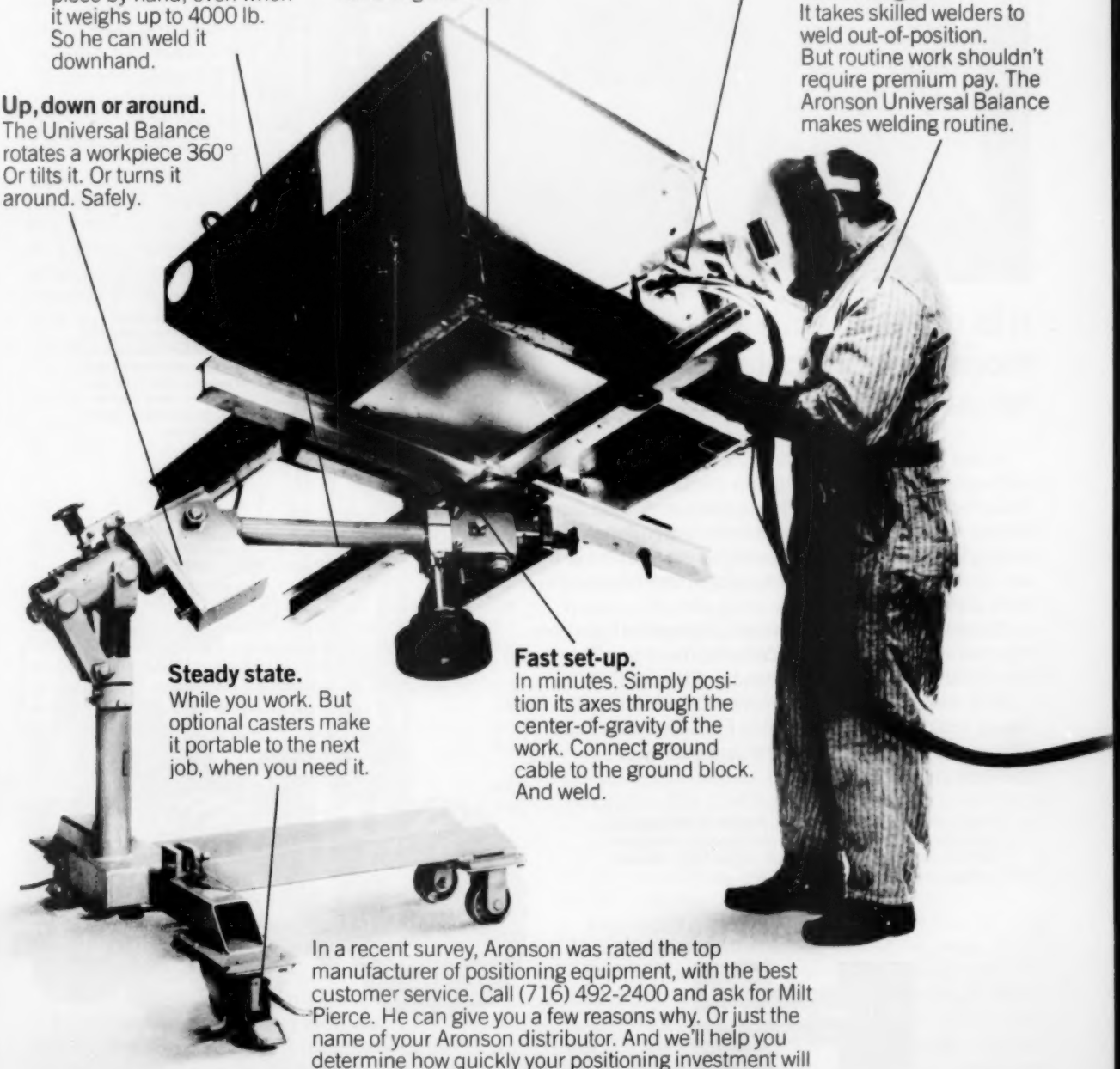
The Universal Balance® Positioner.
We invented it. The Aronson Universal Balance lets a welder turn a workpiece by hand, even when it weighs up to 4000 lb. So he can weld it downhand.

Positioning for assembly.
Don't assemble in one place and weld in another. The Universal Balance speeds production. People even paint without removing the work.

No-work work.
Only finger-tip pressure is needed to move a balanced weldment weighing up to two tons. No need to break an arc or lift a helmet.

Lower wages.
It takes skilled welders to weld out-of-position. But routine work shouldn't require premium pay. The Aronson Universal Balance makes welding routine.

Up, down or around.
The Universal Balance rotates a workpiece 360° Or tilts it. Or turns it around. Safely.



Steady state.
While you work. But optional casters make it portable to the next job, when you need it.

Fast set-up.
In minutes. Simply position its axes through the center-of-gravity of the work. Connect ground cable to the ground block. And weld.

In a recent survey, Aronson was rated the top manufacturer of positioning equipment, with the best customer service. Call (716) 492-2400 and ask for Milt Pierce. He can give you a few reasons why. Or just the name of your Aronson distributor. And we'll help you determine how quickly your positioning investment will be paid back by the savings it generates. Aronson Machine Company, Arcade, New York 14009.

Aronson

Let someone who has a Hayes Vacuum Carburizing Furnace tell you...

Charles Bronson, Chief Metallurgist (left) and Daniel Malone, Plant Superintendent (right) shown above viewing the vacuum carburized gears of a D.C. Powered Electric Wheel for one of their heavy duty machines.

It is more effective, more economical and helps production output!

Daniel Malone and Charles Bronson of Marathon LeTourneau Company, Longview Division in Longview, Texas both agree that the Hayes Vacuum Sealed Quench Furnace has many advantages over conventional methods. "One of the most outstanding features is that we are able to control surface carbon, carbon gradient and case depths.

"In addition, our overall carburizing cycles have been reduced — to attain an .080 case depth we use 32 minutes for carburizing and 150 minutes for diffusion."

Both men agree there are numerous advantages to their Hayes VSQ Vacuum Carburizing Furnace...the most important being the time factor and quality of the work produced.

You're welcome to write C. I. Hayes or call us for more detailed information on the success Marathon LeTourneau is having with their Hayes VSQ Vacuum Carburizing Furnace.

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CIRCLE NO. 9 ON READER INQUIRY CARD

or more persons—almost 50 percent by plants employing 500 or more persons.

Gaging-Inspection-Testing Equipment. The respondents in total will spend 5.6 percent of their investment dollar on gaging-inspection-testing equipment in 1978. This amounts to $379.8 million and is 10 percent more than the $345.1 million invested in 1977. Respondents in the New England, Mid-Atlantic, Mountain, and Pacific regions are allocating a higher proportion of their capital dollars for gaging-inspection-testing equipment as are the plants employing 500-999 and plants employing 1000 or more; they will average 5.7 percent and 7.8 percent more, respectively.

Nationally, plants employing 50-99 will spend $41.2 million or 10.8 percent of the total investment in gaging-inspection-testing equipment; plants employing 100-499 will spend $118.2 million, 31.1 percent; $67.5 million by plants employing 500-999, 17.8 percent; and $152.9 million, 40.3 percent by plants employing 1000 or more.

Industries spending more than the average 5.6 cents of every machinery equipment dollar on gaging-inspection-testing equipment are shown in the table:

SIC	Industry	Percent of Total Capital Expenditure for Gaging-Inspection-Testing
349	Miscellaneous Fabricated Metal Products	6.1
353	Construction, Mining & Material Handling Equipment	6.2
354	Metalworking Machinery and Equipment	6.9
357	Office, Computing & Accounting Machines	14.6
359	Miscellaneous Machinery, exc. Electrical	6.2
361	Electrical Transmission & Distribution Equipment	9.9
362	Electrical Industrial Apparatus	6.4
366	Communications Equipment	13.9
367	Electronic Components & Accessories	10.4
369	Misc. Electrical Machinery, Equipment & Supplies, nec	8.5
372	Aircraft & Parts	5.9
381	Engineering, Laboratory, Scientific & Research Instruments	18.9
382	Measuring & Controlling Instruments	5.9
386	Photographic Equipment & Supplies	13.9

Plastic Molding. The respondents in total report they'll cut 13.4 percent of their investment in plastic molding machinery and equipment in 1978—down to $172.7 million from $204.1 million in 1977. Most of this captive investment will take place in the 11 industry groups shown in the table:

SIC	Industry	Percent of Total Capital Investment for Plastic Molding Equipment
341	Metal Cans & Shipping Containers	12.3
342	Cutlery, Hand Tools, Hardware	4.9
346	Forgings & Stampings	4.0
357	Office, Computing and Accounting Machines	5.4
363	Household Appliances	8.6
364	Electric Lighting & Wiring Equipment	9.3
367	Electronic Components & Accessories	4.6
369	Miscellaneous Electrical Machinery & Equipment	7.5
382	Measuring & Controlling Instruments	5.8
384	Surgical, Medical & Dental Instruments & Supplies	15.3
386	Photographic Equipment & Supplies	6.1

Response from the automakers suggests low activity for their plastic machinery orders in 1978. They report 1.3 percent of the machinery-equipment investment is slated for this category. But with their announced interest in plastic, this position could change in a matter of months.

Plants with 50-99 employees will spend 2.4 percent or $19.8 million, for plastics equipment. Plants employing 100-499 will allocate 2.5 percent of their equipment budget or $61.6 million. Plastics equipment will account for 3.9 percent, $46.2 million, in plants of 500-999 and those employing 1000 or more will spend 2.3 percent, $45.1 million, in 1978.

Geographically, plants in New England with 3.4 percent; Mid-Atlantic, 2.8 percent; South Atlantic, 3.1 percent; East South Central, 2.9 percent; West South Central, 2.8 percent; and the Pacific Region, 3.6 percent, will outperform the national average.

Welding-Riveting-Brazing. The respondents report they'll increase their investments in welding-riveting-brazing equipment by 16 percent over 1977—up to $350 million. This amounts to 5.4 cents of every machinery-equipment investment dollar in 1978.

Industry investment by plant size is indicated in the survey as follows: In plants employing 50-99, 6.7 percent, or $55.2 million, will go for weld-rivet-braze equipment; it's 6.1 percent, $150.2 million, in plants employing 100-499; 4.6 percent, $54.4 million, in plants employing 500-999; and 4.6 percent, $90.2 million, in plants employing 1000 or more.

Regionally, plants allocating a larger proportion of their investment dollar for weld-rivet-braze equipment than the typical respondent nationally are in the West North Central, 7.5 percent of investment dollar; the South Atlantic, 6.2 percent; the East South Central, 7.5 percent; and the West South Central, 8.5 percent.

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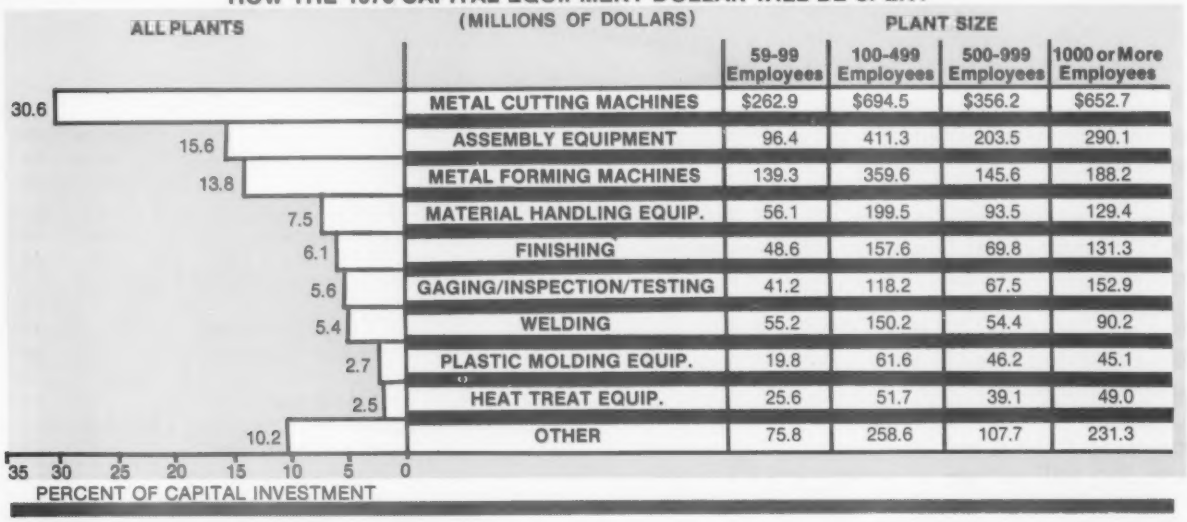
HOW THE 1978 CAPITAL EQUIPMENT DOLLAR WILL BE SPENT



(MILLIONS OF DOLLARS)

	PLANT SIZE			
	59-99 Employees	100-499 Employees	500-999 Employees	1000 or More Employees
METAL CUTTING MACHINES	$262.9	$694.5	$356.2	$652.7
ASSEMBLY EQUIPMENT	96.4	411.3	203.5	290.1
METAL FORMING MACHINES	139.3	359.6	145.6	188.2
MATERIAL HANDLING EQUIP.	56.1	199.5	93.5	129.4
FINISHING	48.6	157.6	69.8	131.3
GAGING/INSPECTION/TESTING	41.2	118.2	67.5	152.9
WELDING	55.2	150.2	54.4	90.2
PLASTIC MOLDING EQUIP.	19.8	61.6	46.2	45.1
HEAT TREAT EQUIP.	25.6	51.7	39.1	49.0
OTHER	75.8	258.6	107.7	231.3

Most of this investment will be concentrated in the 15 industry groups shown on the following table:

SIC	Industry	Percent Weld-Rivet-Braze Equipment Investment by Industry
342	Cutlery, Hand Tools, Hardware	5.8
343	Heating Equipment, exc. Electric & Plumbing Fixtures	7.6
344	Fabricated Structural Metal Products	16.6
349	Miscellaneous Fabricated Metal Products	5.6
351	Engines & Turbines	6.6
352	Farm & Garden Machinery & Equipment	7.0
353	Construction, Mining & Material Handling Equipment	7.6
356	General Industrial Machinery & Equipment	5.7
358	Refrigeration & Service Industry Machinery	5.5
363	Household Appliances	5.9
371	Motor Vehicles, Motor Vehicle Parts & Accessories	6.3
372	Aircraft & Parts	6.4
373	Railroad Equipment	11.4
374	Ship & Boat Building & Repairs	11.8
382	Measuring & Controlling Instruments	8.0

Robots and Stacker Cranes. About 6.2 percent of the responding plants include in their 1978 spending plans purchase of Universal Transfer Devices (industrial robots), up from 5.8 percent a year ago. Location by plant size for UTD investment is indicated in the survey as follows: 16.5 percent in plants employing 50-99; 25.9 percent in plants employing 100-499; 22.4 percent in plants employing 500-999; and 34.2 percent in plants employing 1000 or more.

More than 70 percent of all plants planning to purchase UTDs manufacture forgings and stampings (17.6 percent), miscellaneous fabricated metal products, metalworking machinery and equipment, general industrial machinery and equipment, electrical transmission and distribution equipment, electrical industrial apparatus, appliances, communications equipment, electronic equipment, and motor vehicles and motor vehicle parts.

Interest remains high in storage-retrieval systems with 10.9 percent of the total respondents reporting they are investigating or planning to install these systems in 1978. Almost half, 49 percent, of this activity is taking place in nine industry groups. They are: cutlery, hand tools and hardware; miscellaneous fabricated metal products; farm and garden mechinery and equipment; construction machinery; metalworking machinery and equipment; general industrial machinery; refrigeration and service machinery; communications equipment; and motor vehicles, motor vehicle equipment. Of the plants investigating or planning to install storage-retrieval systems, 95.3 percent employ more than 100 employees.

What's a +4.6 Percent Year Like? Like 1977. We are projecting a "flat year" for 1978—no big jump in capital spending as there was a year ago when the returns projected a 23.7 percent rise in spending. But there will be more in some categories of equipment, a lot more than you spent in 1977. For instance, in 1978 you'll be spending: 9.1 percent more on assembly, 3.2 percent more on metal forming, 11.7 percent more on material handling, 10 percent more on gaging-inspection-testing, 28.1 percent more on cleaning and applied finish equipment, 16 percent more on weld-rivet-braze, and 42.9 percent more on heat treat equipment. You won't be spending as much on metalcutting machines, but you will be spending 43 percent more than you did two years ago.

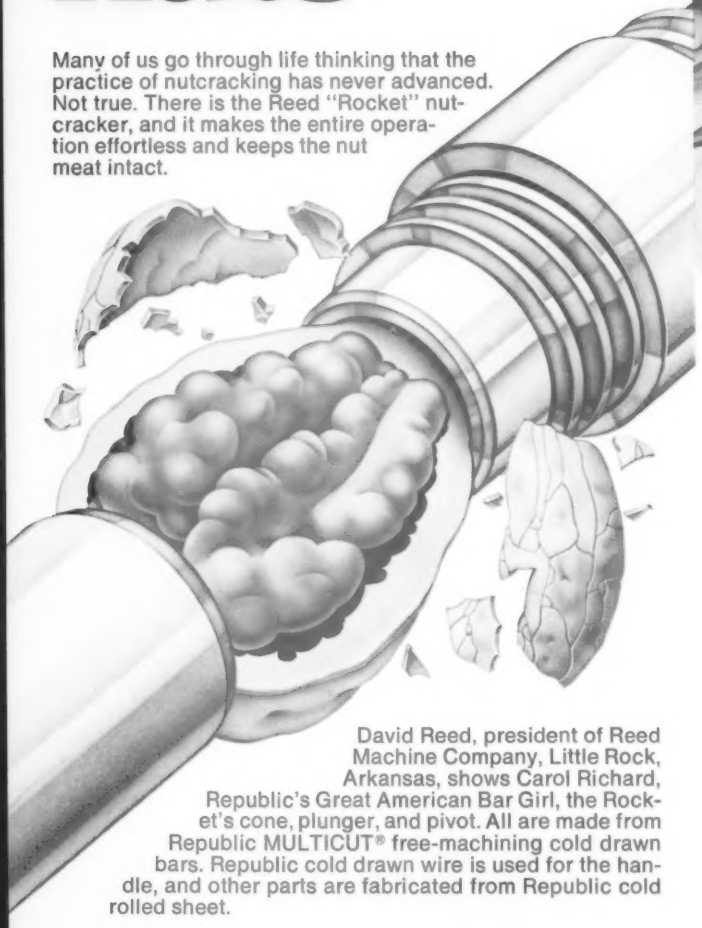
Generally, it should be a good year for both you and your suppliers. *EDM* □

"If you don't believe Republic is everywhere, come along."

We're busy helping to...

crack nuts

Many of us go through life thinking that the practice of nutcracking has never advanced. Not true. There is the Reed "Rocket" nutcracker, and it makes the entire operation effortless and keeps the nut meat intact.



David Reed, president of Reed Machine Company, Little Rock, Arkansas, shows Carol Richard, Republic's Great American Bar Girl, the Rocket's cone, plunger, and pivot. All are made from Republic MULTICUT® free-machining cold drawn bars. Republic cold drawn wire is used for the handle, and other parts are fabricated from Republic cold rolled sheet.

rake clams

You may not have unearthed any clams lately. But thousands do. Along our coasts, the clambake is an increasingly popular picnic idea, and everyone does his own clam digging with rakes like this one.

Carol Richard, Republic's Great American Bar Girl, learns the technique of clamraking from John Butera, president of Port Clam Rake Company, Port Jefferson, New York. The rake's teeth are made from Republic annealed cold rolled special sections, 1095 carbon steel. The frame is fabricated from Republic cold drawn carbon 1095 bars.

wring mops

It's midnight or after when your office is invaded — so you're probably not aware of the White squeeze mop wringer, a time and money saver in floor cleaning. It's the finest of its type, solidly made so that the stress points can withstand tough, continuous use.

Ted Plummer, president of White Mop Wringer Company, Fultonville, New York, a leading company in floor care for over 90 years, explains to Carol Richard, Republic's Great American Bar Girl, how quickly and easily it operates. Carol is pointing to the ⅝" square shaft, fabricated from Republic 1018 cold finished bar — for the ultimate in strength.

change spikes

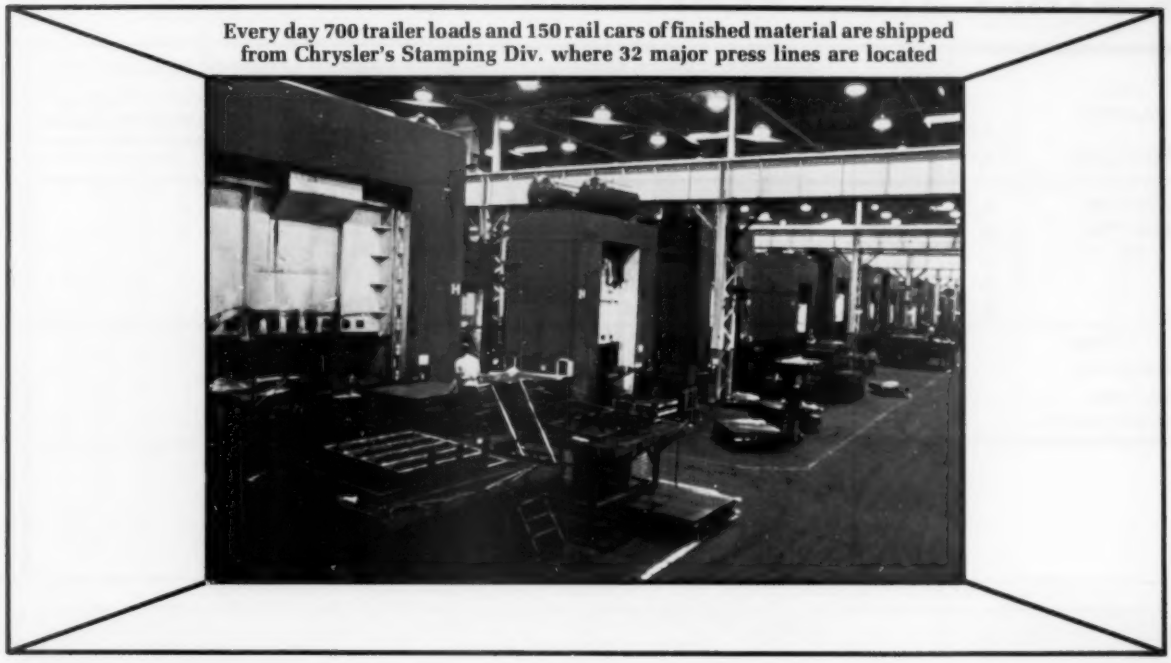
Something else that may be news to you. When it comes to changing golf shoe spikes, you can do it yourself in minutes. This is the Phillips spike changer and you'll probably find it in your pro shop.

F. C. Phillips, Inc., Stoughton, Massachusetts, is a leader in spike manufacturing for all sports. Ed Granger, vice president, tells Carol Richard, Republic's Great American Bar Girl, that Republic MULTICUT® leaded cold finished bars are used for the stem, housing and handle of the spike changer. In addition, the tops of golf and track shoe spikes are fabricated of Republic cold drawn bars.

We're busy helping you make the most of what you make.

You may have overlooked the part our Great American Bars play in items like the nutcracker. But it's difficult to overlook us elsewhere. In giant earthmovers, for example, and in rugged recreational vehicles and heavy-duty farm tractors. In hand tools, outboard motors, sporting arms, drill chucks, shock absorbers, and vacuum cleaners. We're very busy, everywhere. Helping the most successful companies in all these industries become even more successful. Shouldn't we be doing the same for you . . . helping you make the most of what you make? Write for more information, Republic Steel Corporation, Department 1441, Cleveland OH 44101.

Republicsteel
Cold finished bars



Every day 700 trailer loads and 150 rail cars of finished material are shipped from Chrysler's Stamping Div. where 32 major press lines are located

Sheet Steel Quality Sets Press Performance Standards

Chrysler Corp. has developed a system which places responsibility for setting the acceptable quality level of stamped metal parts on its sheet steel suppliers. The program is credited for an astounding drop in scrapped or damaged parts and across-the-board productivity improvements

As recently as 10 years ago, 5 to 7 percent of the stamped metal parts produced by Chrysler Corp.'s Detroit Stamping Div. were rejected due to surface imperfections or breakage.

"Today," says Adrian Garduno, steel specialist-Quality Coordination, "we won't accept a scrap level over 1 percent . . . PERIOD. As a rule of thumb, our sheet steel suppliers now average .05 percent scrap due to breakage, and a .06 percent level of scrap due to surface defects."

Chrysler attributes this remarkable turnaround in supplier performance to a Materials Evaluation & Acceptance program it adopted in 1968. Gorton Goodwin, manager of materials engineering for the Stamping Div., explains what the program has meant to the company.

"For our 1977 series of vehicles, scrap levels averaged .040 percent for sheet steel purchased from foreign mills; .044 percent for steel purchased from domestic suppliers; and .037 percent for sheet steel acquired through steel service centers. This represents a 150 percent improvement over 10 years ago."

Program Scope. The No. 3 automaker's program for measuring steel performance (quality) and controlling rejections covers all flat stock purchased by the Stamping Div. This takes in hot and cold rolled coils and blanks, galvanized, electro-galvanized, and long terne. It was implemented, according to Goodwin, to measure vendor performance as related to the volume of steel sheet each supplied for a specific part. The program itself evolved from the SAE J.424 recommended practices for establishing breakage and surface defect allowances for sheet steel. It has been refined by Goodwin and Garduno, however, in order to make collected data a tool

MONTHLY STEEL PERFORMANCE

PART NUMBER & PART NAME	VEND. CODE	PIECES RUN	PANELS SCRAPPED (BREAKAGE)				PANELS SCRAPPED (SURFACE)				
			QUAN. SCRAP	AQL % SCRAP	CHARGE VENDOR %	CHARGE VENDOR QUAN.	QUAN. SCRAP	AQL % SCRAP	CHARGE VENDOR —	CHARGE VENDOR QUAN.	QUAN REPR
3791086 C-2 PNL D2	A	15,664	372	2.37	1.70	266					
	B	11,807	69	.58	.00	—					
	C	13,276	131	.99	.32	42					
	D	1,375	21	1.53	.86	12					
	E	2,380	0	.00	.00	—					
Total		44,502									
Breakage (50%)		22,251	149	.67							
Surface (30%)		13,350					→ —	—			
Panels Repaired (50%)		22,251									→ —

CALCULATING YOUR AQL

(Based on the above chart)

Procedure for Establishing Monthly AQL for panels scrapped due to breakage is based on 50 percent of total production.

1. Total up vendor production.

   Example - 5 vendors for 44,502 pieces

2. First Step: Establish AQL production - This is 50% of total production 44,502 ÷ 2 = 22,251. 22,251 pieces is our AQL production figure.
3. Second Step: Establish AQL Scrap
   a. Take the production of the vendor with the lowest percent scrap (Vendor E - 0.00%), and subtract production from the AQL production figure. This vendor had no scrap.

      22,251 - AQL production
      - 2,380 - Vendor E's production
      19,871

   b. Next, take the production of the vendor with the second lowest percent scrap (Vendor B - 0.58%) and subtract his production (11,807) from 19,871. His scrap was 69 pieces. This figure will be used later.

      19,871
      -11,807 - Vendor B's production
      8,064

   c. Now go to the vendor with the third lowest percent scrap (Vendor C - 0.99%) and subtract his production from 8,064. His production for the month was 13,276. This figure when subtracted from 8,064 leaves us with a negative value. Instead of Vendor C's production we will use his percent scrap.
   d. Take Vendor C's percent scrap (0.99%) and multiply our last subtracted value (8,064) by it.

      8,064 × 0.99 = 80 pieces

      These 80 pieces represent the portion of Vendor C's scrap we are using in computing our AQL scrap figure.
   e. Add Vendor C's scrap which we found out by percentage factoring (80 pieces) to Vendor B's scrap of 69 pieces. This gives us an AQL scrap figure of 149 pieces.
4. AQL percent scrap is found by dividing AQL scrap by AQL production.

   149 ÷ 22,251 = 0.67%
   0.67 is our AQL % scrap

5. Next subtract our AQL % Scrap figure from each of the percent scrap figures of the vendors. This gives you the percent of chargeback to vendor.

   Vendor
   A 2.37 - 0.67 = 1.70%
   B 0.58 - 0.67 = 0.00%
   C 0.99 - 0.67 = 0.32%
   D 1.53 - 0.67 = 0.86%
   E 0.00 - 0.67 = 0.00%

6. Now multiply this percent chargeback to vendor by the vendor's production. This gives you the number of pieces to chargeback to the vendor.

   Vendor
   A 15,664 × 1.70 = 266
   B 11,807 × 0.00 = 0
   C 13,276 × 0.32 = 42
   D 1,375 × 0.86 = 12
   E 2,380 × 0.00 = 0

The above procedure explains how to calculate the AQL for panels scrapped due to breakage, the AQL being based on 50 percent of total production. The same procedure is used to determine the AQL for panels scrapped due to surface imperfections. In this instance, however, AQL is based on 30 percent of total production. The AQL for panels repaired is based on 50 percent, and also calculated by following the same procedures.

NELS REPAIRED			YEAR TO DATE			
% EPR.	CHARGE VENDOR		TOTAL PCS. RUN	TOTAL BRKGE. SCRAP	TOTAL SURFACE SCRAP	% TOTAL SCRAP
	%	QUAN.				

DEFECTIVE MATERIAL REPAIR CHARGEBACK

(SAMPLE)

	Minutes/Unit					Chargeback/Unit		
Part Name	Repair	Inspct.	Hdlg.	Total	Repair Labor $	Labor	Burden	Total
379801	2.500	.500	.350	3.350	.228	.306	.404	.710
8572-J	9.775	.850	.750	11.375	.891	1.037	1.577	2.614
21413	3.250	.400	.300	3.950	.296	.360	.524	.884
90016	2.500	.500	.350	3.350	.228	.306	.404	.710
B12087	6.000	.400	.050	6.450	.547	.588	.968	1.556
Z00810	1.570	.250	.030	1.850	.143	.169	.253	.422

Burden costed at 177 percent of repair labor

Labor costed at $0.0912/minute

for obtaining better material from the mills. The basic SAE program, Goodwin says, only generated data. It did not tell a metal stamper what to do with the information.

Two fundamental purposes are served by the Materials Evaluation & Acceptance program. First, it generates an acceptable quality level, AQL, figure which manufacturing and purchasing use to identify sheet steel vendors who are supplying defect-free stock, or repeatedly delivering sheet material which generates a lot of scrapped parts. Second, the program establishes a basis upon which unacceptable steel and scrapped or damaged parts can be charged back to the vendor on a mutually agreed upon schedule. A DETAILED, BUT EASILY UNDERSTOOD, EXPLANATION OF HOW THE AQL IS CALCULATED IS PROVIDED IN THE ACCOMPANYING ILLUSTRATION. Its use is explained in the following text.

Program Prerequisites. The only prerequisites needed to implement a program like that in place at Chrysler are: at least three (but not more than five) suppliers of sheet steel for each part covered by the program*, and a well-defined set of standards and procedures to identify the characteristics of acceptable and unacceptable material. This supporting documentation should cover the grade of steel used (commercial quality, drawing quality, drawing quality retarded aging, aluminum-killed drawing quality, etc.), surface appearance requirements, hardness, and physical properties. It should further be established what constitutes an acceptable coil with respect to length, location of welds, dimensional tolerances, number of inner and outer wraps, and so forth, and what constitutes an acceptable lift of cut lengths or blanks. AISI and SAE publish guidelines, including pictures and verbal descriptions of different types of defects, useful in putting together the documentation needed to support a program.

However, Goodwin cautions a company not to believe it can set up a successful program simply by using published data. Procedures must be tailored to specific needs

*A program such as this works best when steel vendors are supplying material in quantities of 100,000 lb (a mill heat). Spot buys require some adjustments in setting the AQL, and are covered later.

and discussed individually with sheet steel suppliers to assure that there is upfront agreement on what is and what is not a damaged part and defective material.

Program Implementation. Once the necessary documentation is assembled, implementation of the Materials Evaluation & Acceptance program can proceed quickly and without much expense or interruption of normal plant operations. The first order of business, according to Goodwin, should be to ensure that all steel sheet supplied is clearly identified when received as to vendor and intended application. This is important, he notes, because any scrap generated from improperly identified material becomes the responsibility of the customer.

Once material is properly identified, the next step involves a pre-production inspection of steel to see that it has not been damaged in transit and that it is the grade, gage, and dimension ordered. It is not unusual to reject steel on the loading dock. When this happens, explains Garduno, Chrysler's policy is to charge the entire shipment back to the vendor on a direct basis. It also assesses a flat rate charge of about $8 per ton to cover handling expenses. Furthermore, if rejected sheet steel is not removed by the vendor within a specified time period, usually 30 days, an additional charge will be assessed to cover storage costs.

Materials accepted by receiving—and clearly tagged as to supplier and application—move to the production floor, a trip which may involve an intermediate stop at the shearing department. If this is the case, a second quality check is made here. As blanks are made from coiled stock, for example, they are inspected for signs of visible or repetitive defects. If such defects are present and exceed 10 percent of coil length, the blanks and remaining steel is set aside for inspection by the customer's quality control people and a mill representative.

Goodwin says Chrysler's procedure in such circumstances is to make a Rockwell hardness test and an Olsen test to determine if readings are within normal limits (based on past experience) for material used to form the part being produded. If doubt remains about the quality of the material after these tests are made, samples will be sent to a lab to check mechanical properties such as yield strength, ultimate strength, percent of total elongation, percent of uniform elongation, and sheet formability.

Shop Floor Controls. Materials which reach the press floor are inspected twice, once after the first 20 hits and at the end of the production run. If defects become evident after the first 20 hits, the lift is set aside for inspection by the vendor. Should the vendor still feel that the lift should be run, Chrysler charges it for each minute of production during which scrapped parts are produced. Because this can prove very expensive, Goodwin says it tends to discourage sheet steel suppliers from pushing the run of marginal quality material.

At the completion of a press run of a specific part with material from a specific vendor, the press operator or foreman uses the only form required for the program. It is

METALLURGICAL GUIDELINES

Chrysler's Stamping Div. expects "Good" steel to fall within the following parameters:

	Rimmed Steel	Killed Steel
Yield Strength	30,000 to 34,000 psi	28,000 to 33,000 psi
Ultimate Yield	44,000 to 48,000 psi	42,000 to 45,000 psi
Total Elongation (%)	29 to 35%	30 to 39%
Uniform Elongation (%)	22 to 28%	24 to 28%
"r" Value (45 deg. direction)	.98 to 1.10	1.15 to 1.35
Formability Index	1.20 to 1.28	1.25 to 1.30 +
Rockwell "B" Scale Reading	38 to 48	34 to 45
Olsen Reading	.360 to .410	.370 to .415

Under the Materials Acceptance and Evaluation program, steel is inspected on the receiving dock for grade, gage, dimensions, and in-transit surface damage

used to record the number of blanks put through the press and the number of scrapped parts produced. This information is recorded by vendor and part number, and provides the basis for calculating the AQL at the end of each month.

Prior to using the Materials Evaluation & Acceptance system, Chrysler had no hard data showing how steel vendors performed in relation to one another. There was an arbitrary AQL figure set by the plant, says Garduno, but it usually turned out to be much higher than what vendors were capable of maintaining. As a result, he says, there was a lot of arguing over what constituted excessive scrap and little progress in solving quality problems. The new program, on the other hand, is equitable because material is judged on what actually takes place in the press over a 30-day period. Steel suppliers themselves set the performance standards by which they are measured.

Vendor Incentives. Because the program is equitable, Garduno says there is across-the-board acceptance of it by all of Chrysler's 40 sheet steel suppliers. It provides them with a number of incentives to supply the highest quality flat stock possible. For example, by keeping the number of rejects produced from their material to a minimum in relation to other vendors supplying steel for the same part, they avoid being charged for scrapped parts in excess of the AQL.

And the better a vendor performs, the more likely it is that it will be awarded more orders. This is because the Materials Evaluation & Acceptance program can be used to establish a reward/penalty system. For example, if three vendors are supplying sheet for a given part, it is possible to reward the supplier having the lowest number of scrapped or damaged pieces by giving it 10 percent of the tonnage of the vendor turning in the poorest performance and 5 percent of the tonnage supplied by the vendor with the second poorest record during the next 30-day evaluation period. Of course, the penalized vendors have the opportunity of recovering lost business by improving their performance the following month.

Vendors have another incentive because their performance on a specific part is measured against other vendors supplying steel for the same part. Consequently, the program administrator is in a position to allocate specific jobs to those steel houses providing the best performance on a given part. This benefits the vendor because it increases its chance of working to the AQL, and of being rewarded with increased orders because of its performance.

Chrysler has also factored a repair cost figure into the program, again to make the program equitable for its sheet steel suppliers. It works this way: Chrysler will make a reasonable attempt to salvage damaged panels by welding, metal finishing, and so on. If parts can be recovered for less than it would cost to scrap them, the

DEFECT DEFINITIONS SIMPLIFIED

Pinchers:
Ripples on sheet which are diagonal to rolling direction. Metal is pinched together during cold rolling due to poor shape of coil.

Floppers:
This defect similar to pinchers only the ripples are transverse to rolling direction.

WNMP: Will Not Make Part or Breakage.
Usually caused by steel being too hard to form part. Causes can be insufficient annealing, high chemistry, excessive skin rolling, etc.

Mill Crease:
Mark across width on inside laps of coil. During skin rolling inside lap is gripped on mandrel and causes a hump on each lap as it is wound around it.

Scale:
Iron oxide not removed by hydraulic sprays on hot mill and consequently rolled into the strip.

Narrow Coil:
Steel coil rolled or slit less than required width.

Mill Slug:
A repeating mark which is caused by foreign object on rolls of skin mill or rewinder or other finishing operation.

Lamination:
Dirt in layers just under skin of sheet. Could be caused by insufficient scarfing of slabs.

Mill Marks—Scratches:
Scratches on surface of sheet caused by objects on table rolls or objects protruding between rolls and striking sheet as it passes.

Pipe:
Void in ingot after solidification which is not removed by crop shear in slabbing mill.

Sticker Breaks:
Marks on sheets left when steel sticks to adjacent laps in coil and is pulled apart during decoiling. Causes are heavy tensions and fast speeds in cold reduction. Annealing gases may have an effect.

Buckled Center:
Oil can effect. Too much metal in spots caused by poor shape from tandem mill or hot mill.

Strain:
Luder's lines or stretcher strains. Lines on sheet caused by localized yielding. Insufficient skin rolling and aging of rimmed steel are causes.

The 100,000 lb of steel you see here represents a 15-day inventory for the Detroit Stamping Div. of Chrysler Corp.

lower of the two figures is charged back to the vendor. And, as with the AQL, each vendor is compared competitively with other vendors on a specific part on a monthly basis. Chrysler establishes the repair cost adjustment by using the best performance of each vendor based on 50 percent of the total monthly run. It establishes annually a repair cost figure for each part number which reflects labor and material costs, repair time, and overhead items such as cost of living allowances, payroll taxes, pension and insurance costs, supplies, electricity, etc.

User Incentives. A company which adopts a program like that at Chrysler also reaps benefits. Foremost, of course, is getting more good parts from the sheet steel purchased. Next comes having a fair method for recovering from vendors the cost of scrapped or damaged parts.

Of equal importance, however, says Goodwin, is that the program allows the performance of the press shop to be constantly monitored. For example, if quality control spots two similar parts with vastly different scrap percentages, it may be an indication that tooling is damaged or a signal that the initial design of one part is improper. On the other hand, an unusually low scrap percentage on a part is a sign that the material is overspecified. Also tied in with this program for rating vendors is an ongoing "downgrading" program. It involves a second look at all panels which are not specified as commercial quality. According to Goodwin, all major panels are etched with .2-in. diameter circles and evaluated for strain after there have been several press runs of the part. (This procedure is explained in SAE J.863, "Methods of Determining Plastic Deformation in Metal Stampings.") Mills supplying steel are requested to review these panels and determine what quality of material can be supplied. The net result, says Goodwin, is that Chrysler is able to realize further savings of materials costs after panels have been in production.

Spot Buys. Recognizing that such vendors as steel service centers cannot provide materials in the same quantities as can a mill, or exercise the same control of material quality, Chrysler has set up separate guidelines for establishing an AQL for spot buys. Where materials do produce a panel are purchased on a spot buy because other materials are not available, says Garduno, a flat 2 percent allowance will be considered acceptable for the perfomrance of that steel unless the actual AQL proves higher. If the AQL is higher, ½ percent over the AQL will be considered acceptable.

Adrian Garduno is convinced that the only way to fairly rate steel sheet suppliers, or suppliers of any other commodity for that matter, is to put them in a competitive situation. In this way, he says, the quality of the product supplied sets the performance standards which the vendors must meet. And "to duplicate a program such as we have for purchasing sheet steel is not all that difficult to do," he emphasizes.

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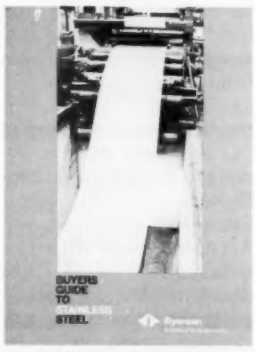
Assuming that the savings from adhering to such a program are sufficient to offset whatever cost there is in administering the program, there are essentially six steps to follow: 1) Select three to five vendors for each part, 2) Develop standards and procedures to judge good and bad material, 3) Establish a system to identify all incoming material by supplier and application and to track it through all production operations, 4) Dry run the system in-house for 60 to 90 days to become familiar with the data generated, 5) Sit down with individual material suppliers to explain the program and establish a mutually agreeable set of rules, and 6) Measure improved productivity and materials utilization approximately three months after starting the system. *BDW* □

Useful Literature

Flat ground steels, including oil hardening, air hardening, and low carbon, are described in a 24-page vest-pocket size data booklet offered by Simonds Cutting Tools.
Circle 473.



A stainless steel buyers' guide which lists in chart form all the facts necessary to help select the most economical type of stainless steel for every application is available from Joseph T. Ryerson & Son, Inc. Some 38 types of stainless steels are described.
Circle 474.

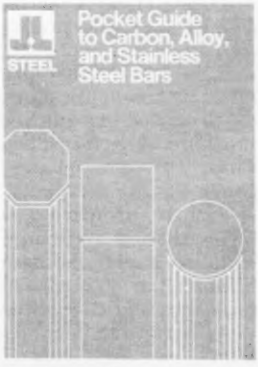
Alloy steel bars are described in a folder presenting comparative data in easy-to-use chart form.
Circle 475.

Laminated plastics are described in a bulletin/chart which gives comparative data on 32 grades of flat stock, tubing, and rod.
Circle 476.

Plastic molding and extrusion compounds, some of the products and processes in which they are used, and the services it offers users of plastics, are outlined in a 4-page brochure offered by Eastman Chemical Products, Inc.
Circle 480.

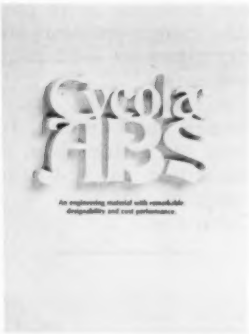
Secondary fabrication techniques for Uvex cellulose acetate sheet, including drilling, sawing, punching, and welding, are described in a 22-page technical bulletin.
Circle 481.

Secondary fabrication techniques for Tenite cellulose plastic are described in a 30-page technical report.
Circle 482.



Carbon, alloy, and stainless steel bars are listed along with useful specifications and application information in a 100-page pocket guide available from Jones & Laughlin Steel Corp.
Circle 484.

Corrosion resistance data on a number of representative types of stainless steel is presented in a 6-page data bulletin.
Circle 485.



Cycolac brand ABS engineering thermoplastic is described and the various product areas in which it finds use are outlined in a 38-page catalog offered by Borg Warner Chemicals.
Circle 506.

Flame-retardant ABS structural foam is described in a 24-page brochure.
Circle 507.

Electron beam treating for hardening the surface of steel and cast iron parts is described in an 8-page brochure by Sciaky Bros., Inc. The base material acts as a heat sink and provides a rapid quench to produce a hardened case.
Circle 508.

Simplified material selection and spring configuration design problems are described in an 8-page brochure available from Associated Spring.
Circle 511.

Helpful facts about springs, custom metal parts, and assemblies are presented in a 10-page folder-type brochure.
Circle 512.

Safety products and materials are discussed in a 24-page condensed catalog offered by Norton Co.
Circle 513.

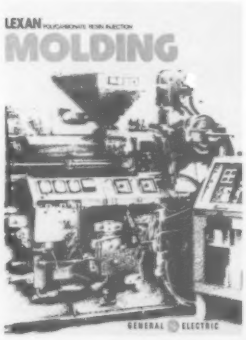
Cast aluminum machined plate and its advantages which include machining

(continued)

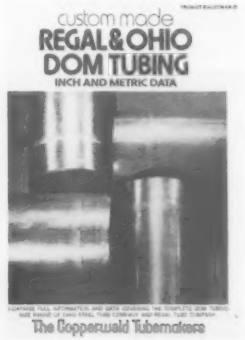
Useful Literature

(continued)

economies, reduced scrap, dimensional stability, weight savings, and weldability are described in an 8-page brochure containing a series of data sheets showing applications and machining operations. Available from Aluminum Co. of America.
Circle 471.



Lexan polycarbonate resin for injection molding is described in a 28-page brochure available from General Electric Co.
Circle 514.
The cost of using Lexan, as compared to diecasting metals, is discussed in an 8-page brochure.
Circle 515.

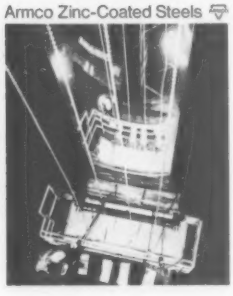


DOM steel tubing produced by Ohio Steel Tube and Regal Tube Co. to inch and metric specifications is described in a 26-page brochure available from Copperweld Tubemakers. It contains useful information on processing and properties and suggested applications.
Circle 493.
Hot forging seamless and welded steel tubing is discussed in a 4-page bulletin.
Circle 494.
Steel tubing fabrications and how they solve product design problems are described in a 12-page brochure.
Circle 495.
Honed steel tubing, in inch and metric sizes, is described in a 6-page brochure.
Circle 496.

Specialty lubricants that extend equipment life and reduce gear wear are described in a literature package containing bulletins and data sheets covering specific products and application case histories available from Dow Corning.
Circle 501.
An arc-resistant silicone compound providing protective coatings for high-voltage insulators is described in a literature package containing a descriptive brochure and an article describing its application.
Circle 502.

Continuous cast bronzes, their main characteristics, and applications are discussed in an 8-page brochure by Asarco Inc.
Circle 497.
Sheet lead for noise reduction is described in an 8-page brochure including machinery enclosures and supplemental walls.
Circle 498.

A ferritic stainless steel alloy that resists pitting and corrosion in harsh environments is described in a 4-page brochure by Allegheny Ludlum Steel Corp.
Circle 472.



The basics of zinc protection on steel is explained, and the available types and common applications are described in a 20-page brochure by Armco Steel Corp.
Circle 466.
A family of nitrogen-strengthened Nitronic stainless steels offering a combination of corrosion resistance and strength is described in a 12-page bulletin.
Circle 467.
Precipitation-hardening stainless steels, their properties, heat treatments, and specifications are described in a 24-page brochure.
Circle 469.
Its complete range of stainless steels is described in a 36-page catalog which includes alloy descriptions, corrosion resistance, physical properties, and relative cost.
Circle 470.

High-strength steel with superior fabricating and welding characteristics, and enhanced properties for forming, drawing, and bending, is described in a 4-page brochure available from Inland Steel Co.
Circle 503.
Heat-resistant aluminum coated sheet steel is described in a 4-page brochure.
Circle 504.
A coated steel with one side coated with light iron-zinc alloy for paintability and the other galvanized for corrosion resistance is described in a 4-page pamphlet.
Circle 505.

A permanent metal marker in the form of a 6-in. writing tube with a ball point is described in a single page bulletin from John P. Nissen Co.
Circle 509.
A low-chloride metal marker for safely marking critical metals is described in a single-page bulletin.
Circle 510.

Ten reasons to buy Bridgeport CNC.

1 Over 650 tool & die shops, mold and job shops, large and small, coast-to-coast, have placed orders for the Bridgeport Series I CNC since its introduction at the Chicago Show, Sept. 1976.

2 Ideal for short runs because programming is fast and inexpensive, equipped with a quick change spindle, job-to-job time is minimal.

3 Handles long runs with confidence, productively, because of the system's excellent resolution and repeatability, and 2 hp continuous duty, fan-cooled, heavy-duty variable speed head.

4 Offers a new dimension in versatility, provides milling needs from simple point-to-point to complex contouring, on one job or many.

5 New "CNC" table rides on a deep, wider saddle for solid workpiece support. X and Y drives are mounted under the table. Motor is mounted on the saddle, eliminating table deflection.

6 Microcomputer, with editor, stores programs and repeats any segment. Can be connected to tape reader, keyboard, computer or CRT for additional input.

7 Comprehensive training in machine programming, operation and maintenance provided year-round. Easy-to-learn. Easy-to-operate. Ideal for getting started in NC or adding to NC capabilities.

8 Optional extras include tape reader, manual data input, programmable inch/metric and remote computer input.

9 Unit responsibility—a major benefit. Machine and control built by Bridgeport. They are dedicated to each other. Training is provided by Bridgeport. And installation, start-up and service are all provided by Bridgeport's nationwide dealer network.

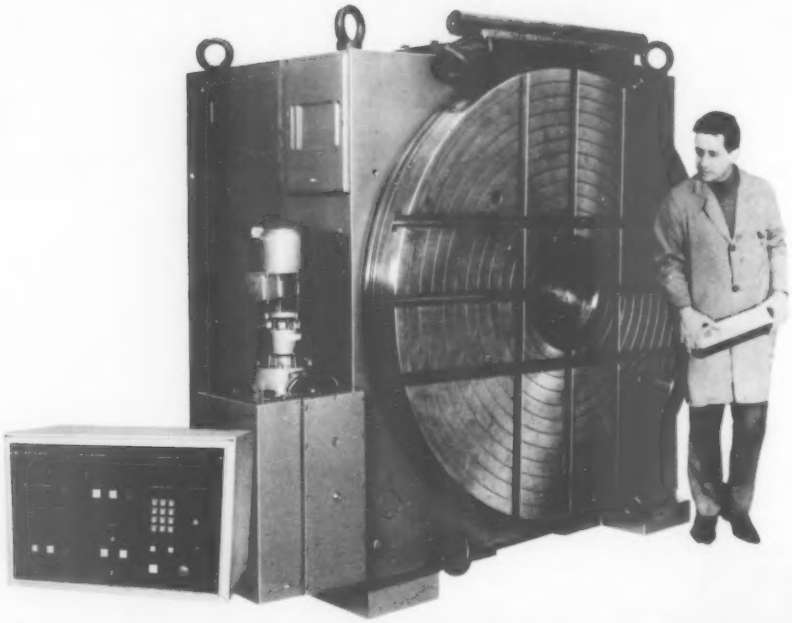
10 And the last and best reason is its suggested list price, FOB Bridgeport. $22,915.

"The most for the least."

Bridgeport TEXTRON

Bridgeport Machines Division of Textron Inc.
Bridgeport, Connecticut 06606

CIRCLE NO. 10 ON READER INQUIRY CARD

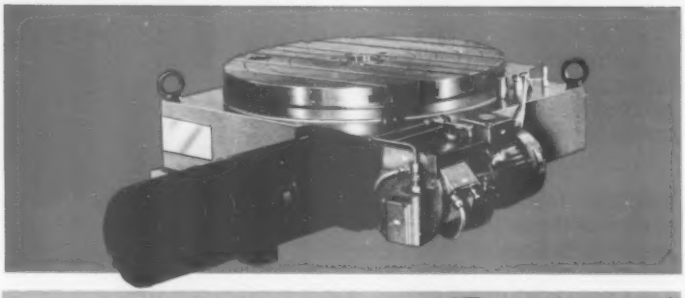


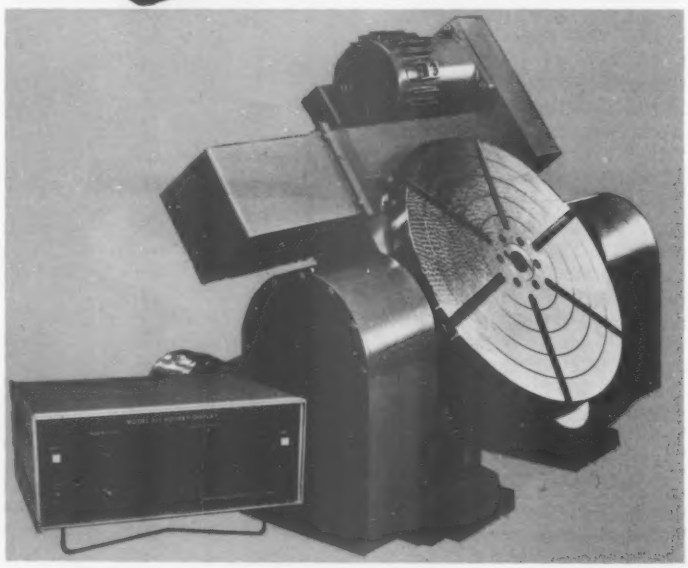
FOR NUMERICAL CONTROL OR ANY OTHER ROTARY MACHINING—

When You Need the Very Best—Ask for Imperial® Tables

APPLICATIONS:

- Indexing, Rotating and Tilting.
- Machining of parts including circular milling, and inspection of parts.
- Retrofit or OEM installations of 4th—5th—6th axes for NC machine-centers, and 3-D measuring machines.
- Assembly and alignment of guidance systems and other applications for aerospace and aircraft requirements.





GENERAL SPECIFICATIONS

OPERATION Manual or motor driven.

CONTROLS Manual, semi-automatic or numerical control.

AXIS Vertical, horizontal or tilting.

ACCURACY Depending on size and application —up to ±1 second or arc, traceable to NBS.

READOUT Mechanical, optical or digital.

SIZES Standard units (round or square) 1-10 ft.—larger on special order.

AVAILABILITY As complete package with control unit or prepared for attaching to your NC system.

PRECISELY WHAT YOU NEED— FOR TILT OR ROTATION!

E. Leitz, Inc.
Machine Tool Division
Rockleigh, New Jersey 07647
(201) 767-1100

CIRCLE NO. 11 ON READER INQUIRY CARD

Estimating Machining Costs --First Step in Successful Planning

The foundation of good planning is good cost estimating. And the accurate cost estimate is basic to making the right decisions in carrying out the plan, modifying it, or abandoning it entirely. On such decisions, profits hang!

The "Why" of production machining cost estimating is very well understood; it's the basic planning and decision making tool of the machine shop manager. The "How" of such estimating is not so well understood; all companies do not embrace the idea that the methods and procedures used in making the estimate are as important as the cost estimate itself.

Westinghouse Electric Corp., however, is one company that does emphasize such methods and procedures. In describing Westinghouse manufacturing cost estimating practices, Consultant J. C. Martin of Corporate Cost Consulting Services says: "Any large decentralized company is bound to have varying procedures for getting things done—even the basics such as estimating—and Westinghouse is no exception.

"In most of our plants, the estimating group is likely to be a part of Industrial Engineering. It can be a separate group of individuals if the volume of such work is considerable. But, more likely, the I.E. assigned to a particular part of the plant operation will be asked to prepare the estimates for products related to his area of responsibility.

"Our industrial engineers have standard time data for most of the operations to which time values must be applied. For machining, the actual machining time is based on utilizing feeds and speeds found acceptable for the material and equipment involved. To this must be added the loading and unloading time—often developed with our computer-aided predetermined time system known as 4M Data—plus the setup time which may be obtained from direct time study, from 4M data, or by valid comparisons with similar work.

Westinghouse-developed 4M Data system may be applied manually, but is often used in computer calculation of estimates as well

"Such data may be applied manually, but in other cases, the computer will be used where the standard time data has been programmed for computer calculation once the parameters are fed in. The Westinghouse-developed 4M Data system (an acronym for Micro-Matic Methods and Measurement Data) has provisions for quickly retrieving various categories of stored data.

"Because the estimator can save time by using the same standard data he would later use for establishing actual time values, he will take the same approach that would be followed in developing a time standard. So the estimating process may follow essentially the same steps as would be followed in preparation of a routing sheet for manufacturing.

"Where estimates are considered to become part of the future work load, they become part of the advance planning picture. Where applicable, this is a computerized procedure, even to the extent that machine loading is considered for some time in the future."

The Bendix Corp. Approach. Bendix Corp. also emphasizes the methods and procedures used in

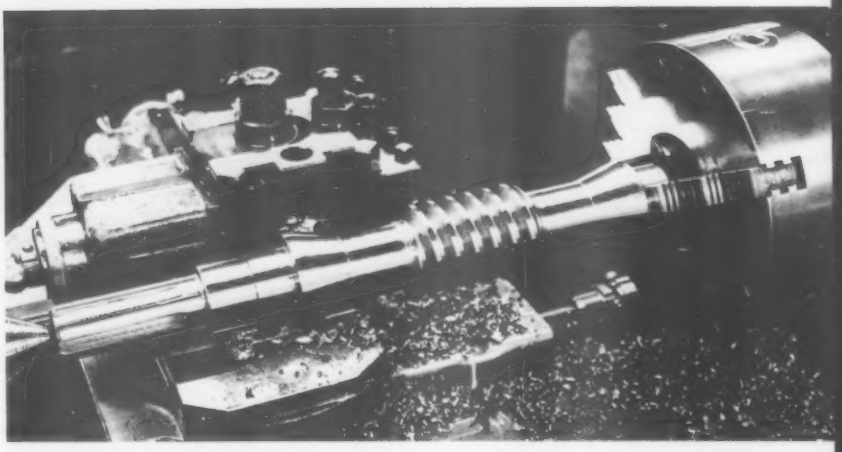
making production cost estimates. Robert A. Badders, director, manufacturing facility & cost planning, Automotive Control Systems Group, describes his organization's technique as follows: "The Bendix Automotive Control Systems Group first must determine which operating unit among its four divisions will have the production responsibility. Then, input from that manufacturing group is only one of three necessary elements that management must consider in cost estimating. The others, of course, are material costs and operating costs. Thus it is necessary for manufacturing, purchasing, and accounting to act in congress to arrive at a viable estimate of product cost.

"Within our manufacturing organization, we use two methods to determine labor hours, capital and tooling costs for a new product. There are subtle differences in these approaches—advantages and disadvantages—though both are acceptable and produce good results. Each operating unit is charged with selecting the approach best suited for its particular operation.

"In Method A, manufacturing engineering organizes a group specifically to handle the costing of all products within that facility. Its sole responsibility is to provide labor hours, capital and tooling requirements to the accounting department.

"Depending upon the size of the operating unit, this group can vary from as few as three individuals to an infinite number. It will include a group leader well experienced in virtually every phase of the manufacturing process, an engineer knowledgeable in machining and/or stamping operations, and an assembly expert.

"At Bendix, we try not to look at a cost estimate as a collection of issues necessary to make a new product. Instead, we start at the end and work backward to each individual operation be it machining, plating, assembly, or whatever is required to produce the product, including material handling, stores, etc.



In one method used by Bendix ACS Group, the estimating team reviews the product and processes and determines the controlling operation based on feed and speed rates of the various operations

"The estimating team reviews the product and processes, and determines the controlling operation based upon feed and speed rates of the various operations on the parts required to feed the assembly operation.

"Depending upon the desired number of units to be produced, a base-type of machine, ranging from numerical control machining centers to index machines to transfer machines, will be selected. The number of required stations is determined and then the number of machines necessary. Until recently, Bendix personnel estimated the cost of these machines, but because of extensive increases in the cost of machine tools during the past few years, we now often obtain quotes from machine tool vendors.

"All information generated then is entered on a form provided by the accounting department. On this form, we detail by operation, the labor hours, the capital, the tooling, and the estimated maximum production. The same form includes similar information for all other necessary operations such as assembly, material handling, etc.

"This information then is compiled into a booklet as a permanent part of the total cost request file. It requires the review and signatures of the Manufacturing Engineering Manager, the Director of Manufacturing, the Director of Quality and Reliability, and, in some cases, the manager of the particular product group.

"In Method B, the manufacturing engineering group is segmented by the various manufacturing process specialties. As a request for new product cost is presented to this group, the group leader determines the make/buy pattern, and the request then is broken down into the various specialty areas.

"Each group or individual estimates the cost of those operations within his or her expertise. Essentially the same process as in Method A is used in determining the type and number of machines, etc. Data inputs then are compiled into a booklet as part of a permanent file. The total project then is approved by the Manufacturing Engineering Manager, and, in some cases, by the Director of Manufacturing, prior to submission to the accounting department."

Advantages and Disadvantages. According to Badders, the use of Method A is preferred in a growing

operating unit where new products continually are being introduced and where major changes in the product base are anticipated. He believes the separate cost estimating organization, in these circumstances, produces more accurate and competitive estimates with less chance of error in the total cost structure.

On the other hand, in a more stable operating unit where products are well established and rate of growth is less, he recommends the conventional process engineering method—Method B.

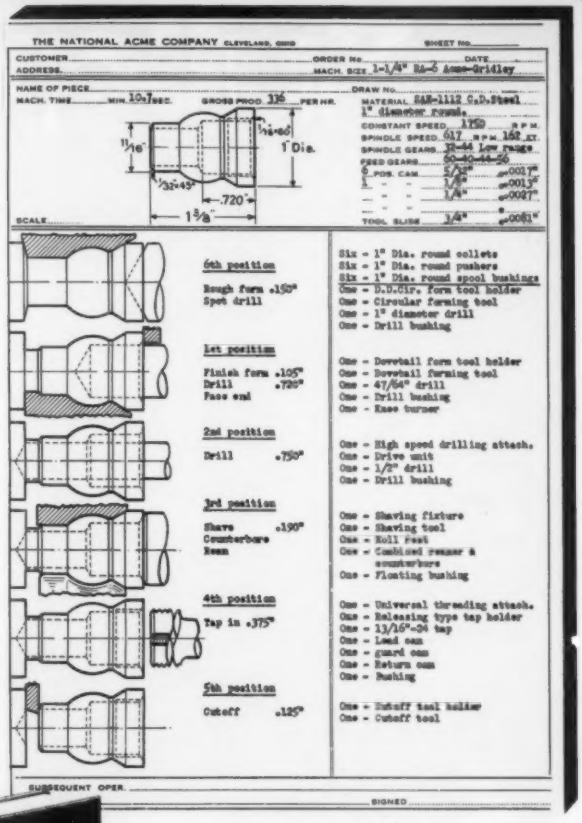
The advantages of Method B are listed as: The individuals involved are specialists, and generally having been responsible for process changes in their areas of expertise, are more up-to-date on current methods and techniques; since they have responsibility to the manufacturing floor, usually they are more cognizant of possible problems.

The disadvantages of Method B are that: Since the major responsibility of these specialists is to the manufacturing operation, they are less likely to welcome changes; they do not always give highest priority to requests for cost estimates; and since they "must make it work," they are less innovative or are minimum risk takers.

Regardless of which of the two methods is used, however, Badders summarizes the desired result in these words: "At Bendix, we emphasize realistic estimating of product cost as one of the most important factors in establishing a new product line or revising an established production item."

Machining Data and the Computer. Both Westinghouse's Martin and Bendix's Badders emphasize the use of reliable data as being the basis of good estimating. Machinability data can be obtained from charts and tables available from machine builders, tool manufacturers, materials producers, handbooks, etc.; and from experimental studies or historical

(continued on page 55)


THE NATIONAL ACME COMPANY CLEVELAND, OHIO

CUSTOMER ORDER No. DATE

ADDRESS MACH. SIZE 1-1/4" RA-6 Acme-Gridley

NAME OF PIECE DRAW No.

MACH. TIME MIN. SEC. GROSS PROD PER HR.

MATERIAL SAE-1112 C.D. Steel 1" diameter rounds

CONSTANT SPEED R.P.M.

SPINDLE SPEED R.P.M.

SPINDLE GEARS

FEED GEARS

CAM

TOOL SLIDE

SCALE

6th position
Rough form .150"
Spot drill

1st position
Finish form .105"
Drill .720"
Face end

2nd position
Drill .750"

3rd position
Ream .190"
Counterbore
Ream

4th position
Tap in .375"

5th position
Cutoff .125"

Six - 1" Dia. round collets
Six - 1" Dia. round pushers
Six - 1" Dia. round spool bushings
One - D.C.Str. form tool holder
One - Circular forming tool
One - 1" diameter drill
One - Drill bushing

One - Dovetail form tool holder
One - Dovetail forming tool
One - 47/64" drill
One - Drill bushing
One - Knee turner

One - High speed drilling attach.
One - Drive unit
One - 1/2" drill
One - Drill bushing

One - Shaving fixture
One - Shaving tool
One - Roll Pack
One - Combined reamer & counterbore
One - Floating bushing

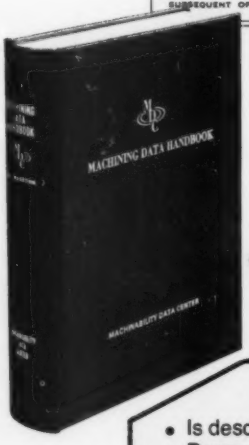
One - Universal threading attach.
One - Releasing type tap holder
One - 13/16"-24 tap
One - Lead cam
One - guard cam
One - Return cam
One - Pushing

One - Cutoff tool holder
One - Cutoff tool

SUBSEQUENT OPER.

SIGNED

▲ On multiple operation machines, the estimate also must include detailed information similar to this tooling layout and setup chart for a part to be machined on a 1¼ in. RA-6 Acme-Gridley

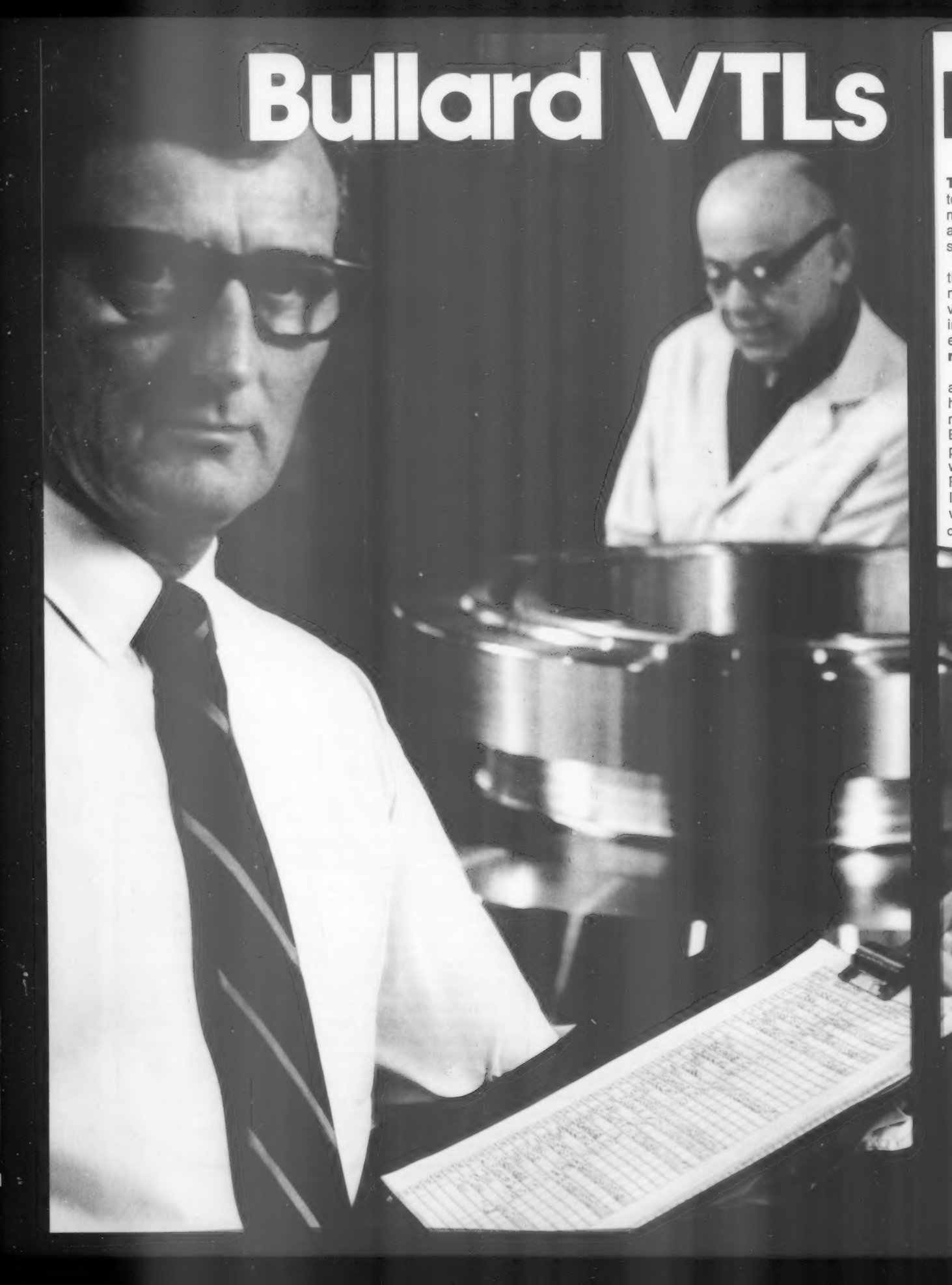


◀ Most comprehensive source of machining data for use in estimating is MDC's Machining Data Handbook (second edition)

ESTIMATING INFORMATION CHECKLIST

- Is description of material complete (form, condition, etc.)?
- Does part drawing show finish specifications? Heat treatment? Finish dimensions?
- Are tolerances reasonable?
- Has projected quantity been determined? For 1 year? For 5 years?
- Has preliminary process routing been developed?
- Has type of machine been decided?
- Is the equipment on hand? To be purchased?
- Is cutting data for material and tools on hand?
- Is machine capability known (hp, table size and travel, traverse rates, etc.)?
- Have type of fixtures been decided?
- Is standard data for labor times available?
- Has tool change frequency been considered?
- Have maintenance and utilization factors been considered?
- Have you considered scrap and rework factors?
- Have you checked the economics of every alternative?
- Every possible variation?
- Has floor area requirement been checked? Material handling equipment? Inventory?

Bullard VTLs



mean business.

The big decision: Buying machine tools is a critical process, involving many individuals, a great amount of time and much responsibility. Such decisions significantly affect profitability.

When large vertical lathes are involved, the effects are compounded—involving major initial investment, careful planning, valuable floor space, extensive engineering, personnel, production projections, expensive parts and, above all, **return on that investment.**

As the leading builder of VTLs for almost a century, The Bullard Company has been acutely aware of the production needs of thousands of customers. At Bullard, the process of evaluating large part turning efficiencies for customers, worldwide, is on-going. We know that R.O.I. must be **justifiable before the fact.** In earlier years, The Bullard Company worked with another "R." Then it stood for "Results." Customers wanted VTLs built to do the best job possible and, to last. Bullard built the best machines they could. And, they lasted. So well that some 19th century Bullards are still producing today.

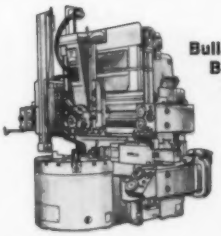
CIRCLE NO. 12 ON READER INQUIRY CARD

Today it's different. Needs must be fully evaluated before committing to and specifying a major machine tool. Marketing strategies, production philosophies and technologies available often demand the involvement of many individuals in the process—planner, programmer, executive, mechanic, buyer and builder. Performance can be analyzed in terms of floor-to-floor time, change-over efficiency, up time per shift, shifts required, processes available, accessories, and automation—every factor that affects costs.

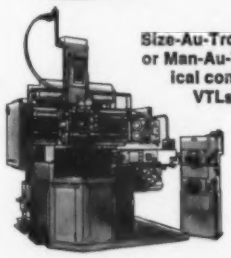
Available to the VTL buyer are a wide range of sizes and configurations, machines with semi or full automatic controls, or with NC, CNC and DNC. With automatic tool changing systems. And other capabilities such as tracing, thread cutting, and precision grinding.

The VTL your company buys today will **outlast the investment period.** Especially if it's a Bullard. Yet justification cannot be based on the ultimate intangible. It's now. Or soon. To meet your investment goals.

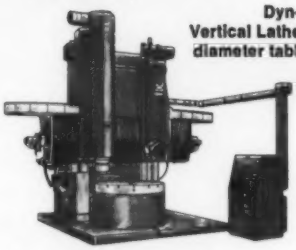
We know. Today's Bullard Company is working with you—today's manufacturer. We know the VTL business. We know how to build maximum efficiency into your turning system. We know we can help you analyze your turning needs. We know we can build the right VTL for you. **Bullard VTLs really do mean business. Yours.**



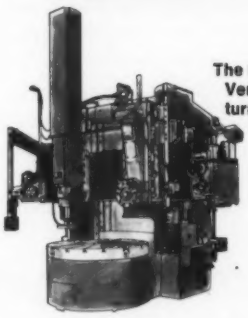
Bullard Dynatrol® VTLs and Boring Mills. 26″ to 124″ diameter tables. Turret and/or ram head with side head option. Manual operation.



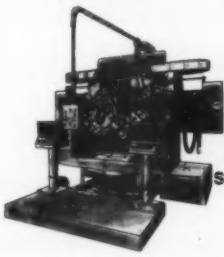
Size-Au-Trol® mechanical control or Man-Au-Trol® electro-mechanical control added to Dynatrol VTLs increase machine capabilities at low cost.



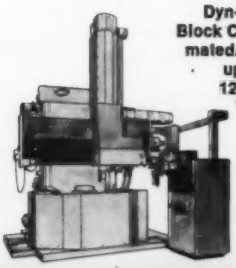
Dyn-Au-Tape® NC Vertical Lathes. 36″ to 124″ diameter tables. With turret and/or ram heads and/or side heads.



The Bullard cut-grinder. Vertical lathe with one turret or ram head and one precision grinding head. 36″ to 124″.



Vertical Precision Grinder. 1 or 2 spindle plunge or reciprocating. Integrated microprocessor available to provide computerized wear compensation. Swing capacities to 98″.



Dyn-Au-Tape® NC Tool Block Changer. Fully automated. Programmable for up to 31 tools. 36″ to 124″ diameter tables. Virtually eliminates down time.

BULLARD

THE BULLARD COMPANY

One of the White Consolidated Industries

WCI

Bridgeport, Connecticut 06609

For Numerical Control or any Other Machine-Tool Indexing--

When you need highly-precise, power-operated indexing — ask for Fibro® tables

GENERAL SPECIFICATIONS

AXIS:
Vertical, horizontal or in-between.

OPERATION:
Pneumatic, hydraulic, combined or motor driven.

INDEXES:
Fixed, variable or infinite (contouring).

CONTROLS:
Manual, semi-automatic or numerical control (tape, memory, thumb-wheel selector).

SIZES:
4-40 inches — round or square.

ACCURACY:
Standards ± 3, ± 6 or ± 15 seconds of arc (On request, ± 1.5 seconds of arc) — all traceable to NBS.

LOAD CAPACITIES:
Standard up to 5,260 lbs.

Fibro® Rotary Indexing Tables are available for indexing (360 and 720 positions) or for contouring (360,000 positions).

Fibro Indexing Tables incorporate "HIRTH" serrated couplings and operate with lifting or **non-lifting** table tops.

Fibro® —the most complete line of indexing and rotary tables for OEM and machine-tool retrofit.

E. Leitz, Inc.

Machine Tool Division
Rockleigh, N. J. 07647
Tel.: (201) 767-1100

Fibro Precision Doesn't Wear Out — It Wears In!

CIRCLE NO. 13 ON READER INQUIRY CARD

(continued)

N/C MACHINING COSTS AND OPERATION TIMES
FOR
PART NO.-456987-002 • PART NAME-BRACKET-SLIDER • LOT SIZE- 20
MATERIAL-AISI 4340 STEEL,NORMALIZED,ACICULAR • HARDNESS- 331

DATA SET NO.	OPER NO.	MACHG OPER.	TOOL MATL	SPEED SFM	FEED	TOOL LIFE	FEED COST	RAPID TRAV	LOAD UNLOAD	SET UP	TOOL INDX	TOOL REPL	TOOL DEPR	TOOL SHPN	BLAD RSET	INST COST	GRND WHL	TOOL PRST	TOTAL COST	OPER. TIME MIN.
30001	N010	FM-TA	C-6	670.	0.005	47.	0.64	0.23			0.08	0.08	0.00			0.06		0.12	1.24	1.27
30002	N010	FM-TA	C-6	540.	0.005	70.	0.80	0.23			0.08	0.05	0.00			0.04		0.08	1.31	1.42
30003	N010	FM-TA	C-6	445.	0.005	83.	0.97	0.23			0.08	0.04	0.00			0.03		0.06	1.45	1.62
30004	N010	FM-TA	C-6	365.	0.005	95.	1.25	0.23			0.08	0.04	0.00			0.03		0.05	1.71	1.95
30005	N020	EM-HSS	M2	155.	0.004	50.	2.78	0.15			0.08	0.32	0.16	0.33			0.01	0.33	4.18	4.02
30006	N020	EM-HSS	M2	100.	0.004	100.	4.31	0.15			0.08	0.16	0.08	0.16			0.00	0.16	5.13	5.67
30007	N020	EM-HSS	M2	80.	0.004	140.	5.38	0.15			0.08	0.11	0.05	0.11			0.00	0.11	6.04	6.91
30008	N020	EM-HSS	M2	70.	0.004	220.	6.15	0.15			0.08	0.07	0.03	0.07			0.00	0.07	6.65	7.79
30009	N030	EM-HSS	M2	65.	0.002	50.	3.33	0.25			0.08	0.10	0.03	0.10			0.00	0.10	4.03	4.55
30010	N030	EM-HSS	M2	54.	0.002	110.	4.01	0.25			0.08	0.04	0.01	0.04			0.00	0.04	4.51	5.30
30011	N030	EM-HSS	M2	43.	0.002	190.	5.04	0.25			0.08	0.02	0.00	0.02			0.00	0.02	5.47	6.52
30012	N040	DRILL	M1	90.	0.002	10.	0.45	0.22			0.08	0.24	0.00	0.08				0.20	1.30	1.21
30013	N040	DRILL	M1	74.	0.002	25.	0.55	0.22			0.08	0.09	0.00	0.03				0.08	1.07	1.15
30014	N040	DRILL	M1	60.	0.002	50.	0.67	0.22			0.08	0.04	0.00	0.01				0.04	1.09	1.25
30015	N040	DRILL	M1	50.	0.002	80.	0.81	0.22			0.08	0.03	0.00	0.01				0.02	1.19	1.39
30016	N040	DRILL	M1	74.	0.005	5.	0.22	0.22			0.08	0.49	0.00	0.16				0.40	1.61	1.23
30017	N040	DRILL	M1	45.	0.005	25.	0.36	0.22			0.08	0.09	0.00	0.03				0.08	0.88	0.92
30018	N040	DRILL	M1	36.	0.005	50.	0.45	0.22			0.08	0.04	0.00	0.01				0.04	0.87	0.97
30019	N040	DRILL	M1	30.	0.005	90.	0.54	0.22			0.08	0.02	0.00	0.00				0.02	0.91	1.06
LOAD, UNLOAD AND SETUP TIME AND COST									1.66	2.49									4.15	5.00

NOTE - FEED UNITS ARE IPR FOR TURNING, DRILLING, REAMING, AND CENTERDRILLING OR CHAMFERING
FEED UNITS ARE IPT FOR MILLING

TOOL LIFE UNITS ARE IN. FOR MILLING, DRILLING, REAMING, AND TAPPING
TOOL LIFE UNITS ARE MIN. FOR TURNING
TOOL LIFE UNITS ARE NO. OF HOLES FOR CENTERDRILLING OR CHAMFERING

Printout of NCECO computer program results for an NC machining center shows 12 cost factors and computed total time and cost for different data sets

records or collections of standard data, time studies, etc.

One of the most comprehensive sources of machinability data is the Machinability Data Center, 3980 Rosslyn Drive, Cincinnati, OH 45209. This DoD Information Analysis Center is operated by Metcut Research Associates Inc. Its services include publication of the Machining Data Handbook (second edition)—which contains more than 41,000 recommendations for machining 1100 different materials on 55 different types of operations, and a computerized file containing over 32,000 documents pertaining to machining technology.

But, while valid and accurate data are most important to the cost estimating function since the value of the estimate itself will depend on the accuracy and the completeness of the data, the way these data are used in calculating the estimate is no less important. And, making the lengthy calculations required is a most tedious, time consuming, and frustrating task for the estimator. It is small wonder that few estimators want to run through the calculations necessary to discover which of several alternative proposals will be most economical.

As Mr. Martin mentioned earlier, the computer can be used to make these calculations quickly, accurately, and easily. But first, it must be programmed to do so.

Recently, the Machinability Data Center developed such a program written in basic Fortran IV language for the IBM 1130 computer (and others with modifications). Called NCECO (NC ECOnomics), the program can be used to determine machining costs and operation times for both Numerical Control machines AND conventional machine tools.

Other than general information such as part number and name, lot size, etc., input information required falls in three categories: Machinability parameters; Time study and cost data; Part geometry and tool motion data.

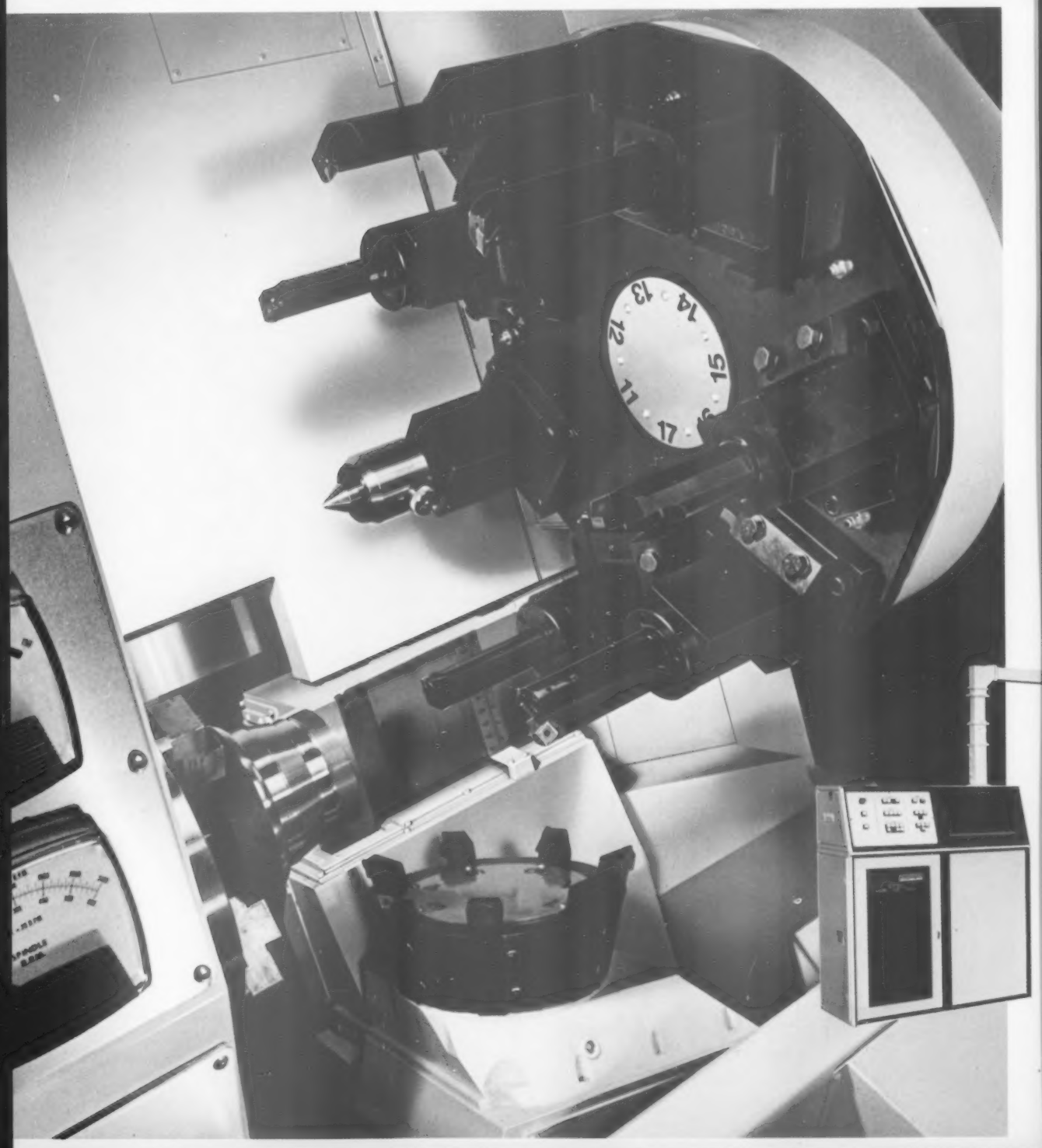
Machinability data for a specific material, with its hardness and condition defined, includes: tool life, cutting speed, feed rate, number of cutting teeth, tool material, tool geometry, cutting fluid, depth of cut, width of cut and tool life end point. (Together these elements make up a single set of conditions and are identified as an individual data set for comparative analysis with other data sets.)

Time study and cost data includes: labor and overhead rate for the machine and operator, tool indexing time, time required to replace dull tools, machine setup time, workpiece loading and unloading time, plus all tool cost elements.

Part geometry and tool motion data includes: diameter of tool or workpiece, depth of cut, length of cut, width of cut, extra travel of

(continued on page 59)

New CINTURN®



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Two unique 7-tool turrets ... on two separate slides ... with an interference-free work zone equal to full chuck diameter!

A tool from each turret attacks your work pieces at the same time. Each cuts independently, moving on its own separate slide. The interference-free work zone for all 14 tools ranges up to full chuck diameter, one of the largest clear work envelopes you have ever seen for machines of this size.

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Rest Easy With Your New CINTURN Workhorse

Programming comes easier with our unique "common tool point" concept. And complete software is available. Get it from Milacron or from selected national time-sharing services. Complete documentation ships with your machine.

Deep blocking passes come easy for the 50 (or optional 75) hp DC spindle drive. Wide spindle speed ranges insure turning versatility in many materials. Three 4-axis chucking models from which to choose—12″ and 15″ (with 14 tools) and 18″ (13 tools). And an 18″ shaft-turning model with 14 tools in two crown turrets, bed lengths of 60″, 80″ and 100″.

One Source Saves Time and Trouble

We bring you the machines. And we make their ACRAMATIC® CNC consoles, too. We teach your people. We help you install, set-up, and get going. And we help you *keep* going with the largest resident and factory field service team in the industry. Call your Milacron man today. Or write us at Cincinnati, Ohio 45209.

CINCINNATI MILACRON

Far left: CINTURN 4-Axis Chucking Model, 7 OD tools in lower turret, 7 ID tools in upper turret. 6 ID tools with 18″ chucking models.

Work area enclosures removed to display features.

CIRCLE NO. 14 ON READER INQUIRY CARD

"inner resources"

Every city of the ancient world fell at least once to an invader – except Constantinople, now called Istanbul. The city was besieged seven times, yet never yielded. Once it was surrounded for more than a year by land and by sea. The secret of its survival was a cavern underneath the city, carved out of solid rock about 100 B.C. Rain water was funneled into the cavern to become a limitless supply of fresh water. It provided a spring of power within the city which was never exhausted.

Competitive struggle in the business world is accepted as inevitable. Persons at every executive and supervisory level are subject to a certain amount of pressure. That individual is fortunate who taps inner resources which enable him to function effectively.

Honesty of effort, respect for other persons, and an awareness of his hidden potential builds up efficiency. The man who utilizes all of his talents and abilities reflects poise and calmness. He resists the tendency to panic when he is pressured or criticized. His dedication to be his best and to do his best builds the inner resources which contribute to personal power.

Many otherwise successful individuals lose their momentum and effectiveness because they are not certain that what they do, or fail to do, has significance for the company which employs them, or for the world in which they live. Every person needs the undergirding assurance that his life has meaning, that his work is important.

A group of engineers in a large corporation attended a dinner. The conversation centered on the deplorable state of society as evidenced by the continuing threat of a nuclear holocaust. Most of the men were pessimistic concerning the future. One voice was raised to affirm that enduring values would eventually triumph. The man reflected a poise and quiet confidence which was missing in the others who were seated at the table. He possessed inner resources which led to an unshakeable certainty that his work and influence contribute to a better society. Each day his life has purpose – for himself and for his world.

That man is wise who dips constantly into resources of inner power. He will never surrender to attacks of boredom, or to fear of failure. He gives his best to whatever he is called upon to do. He lives every day with the calm assurance that there are purposes in the universe which his efforts will help to bring to reality.

Integrity, maximum effort, and an awareness of Ultimate Values have their rewards. They build up a reservoir of confidence upon which a man can draw. Every day becomes a new challenge. Life has purpose, and is characterized by inner strength.

DR. G. ERNEST THOMAS

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CIRCLE NO. 15 ON READER INQUIRY CARD

MDC	TURNING/INSERTS - COST & PRODUCTION *Metcut Research Machinability Programs*				DATA ENTERED	DATA OUTPUT					
						COST ($)		PROD. TIME (MIN.)		PARTS PER EDGE	
STEP		KEYS		OUTPUT							
1	Load Strip										
2	Initialize	RTN	R/S	3.00↑							
3	Load-Unload Time min	ENTER			2.3						
	Index Time min	ENTER			0.1						
	Rapid Trav Dist in.	ENTER			27.2						
	Rapid Trav Rate in/min	R/S		4.00^	100.						
4	Insert Cost $	ENTER			2.50						
	# Cutting Edges	ENTER			8.						
	Set-up Time min	ENTER			21.						
	# Pieces in Lot	R/S		5.00↑	20.						
5	Preset Cost $	ENTER			0.60						
	Overhead $/min	ENTER			0.30						
	Dull Tool Rep Time min	R/S		6.00↑	.4						
6	Diam. Work in.	ENTER			3.5						
	Extra Travel in.	ENTER			0.2						
	Length of Cut in.	R/S		7.00↑	19.						
7	Tool Life min	ENTER			Ⓐ 15. Ⓑ 60.						
	Speed fpm	ENTER			162. 95.					Ⓐ	Ⓑ
	Feed ipr	R/S		PTS/TL	0.01 0.01					1.4	3.3
8	for Times	f-1	SF1			Ⓐ	Ⓑ	Ⓐ	Ⓑ		
	or for Costs	f	SF1			1.12	1.12	3.72	3.72		
9	Constant (cost or time)	A		$orMIN		3.26	5.56	10.86	18.52		
	Feeding (cost or time)	B		$orMIN		.74	.32	.29	.12		
	Tool (cost or time)	C		$orMIN		5.11	6.99	14.87	22.36		
	Total (cost or time)	D		$orMIN							
*	for New Tool Life, V&F	E		7.00↑							
*	for New Geometry	GTO	6 R/S	6.00↑							

An example of cost and production time analysis using MDC magnetic strip program in an HP-65 pocket size programmable calculator. Note, that in this case, in the final figures at right, Method A is less expensive ($5.11 to $6.99), and takes less time (14.87 minutes to 22.36), because the speed is faster (162 fpm vs 95). And the economics favor A even though it will result in only 1.4 parts per edge vs 3.3 on tool life

(continued)

tool in feed but not cutting, distance traveled in rapid traverse, and rapid traverse rate. A code number identifying the operation and type of cutting tool also is required.

The results of the computer's calculations appear as a printout (see accompanying illustration) showing twelve cost factors and the computed total cost and operation time for each data set. (Load-unload and prorated setup time and costs also are shown.)

MDC reports that the strength of NCECO analysis lies in reducing the available machining, cost, and time standards data to cost numbers that yield a more precise comparison of alternative machining conditions than the traditional practice of selecting machining conditions without detailed cost analysis.

Programmable Calculators, Too. For those estimators without access to a computer, MDC also has developed a simplified version of NCECO for use with hand-held or desk top programmable calculators. Called "Machining Cost and Production Time Analysis Programs," they are available as magnetic strips for insertion in Hewlett-Packard calculator models HP-65, HP-67, and HP-97; or as magnetic tape cartridges for the Tektronix-31 desk top programmable calculator.

Following input of data as directed, the calculator produces cost in dollars, production time in minutes, and parts per cutting tool edge. Individual strips or tapes are required for analysis of different types of operations.

Obviously, there are many methods and procedures that can be used to establish accurate machining cost estimates. And the computer and electronic calculator have become important time saving tools in this endeavor. Perhaps it is time now to review the estimating function with an eye to improving this very important manufacturing function. *CH* □

Useful Literature

Retoolable rotary transfer machines for high volume production are described in a 16-page brochure available from Custom Products Corp.
Circle 311.

Rotary transfer machines of standardized, building block design for machining large forgings and castings are described in a 4-page folder.
Circle 312.

Cylindrical and centerless OD grinding are described in an 82-page booklet by Norton Co. It includes tricks that increase production and cites common faults and their remedies.
Circle 318.

Abrasives and grinding wheels are described in a 114-page booklet.
Circle 319.

Roll grinding and grinding wheel recommendations for a variety of rolls and materials are presented in a 112-page booklet.
Circle 320.

The A-B-C's of internal grinding are covered in a 76-page booklet.
Circle 321.

Tool room grinding, including procedures and equipment, is covered in a 200-page booklet.
Circle 322.

Vertical milling machines, numerically controlled, and with automatic toolchanger systems, are described in a 16-page write-up offered

(continued)

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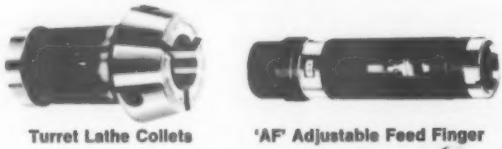
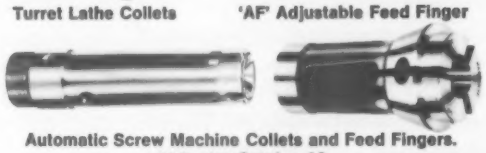


Turret Lathe Collets **'AF' Adjustable Feed Finger**



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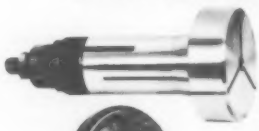

Dead Length Collet, and Step Chuck
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CIRCLE NO. 16 ON READER INQUIRY CARD

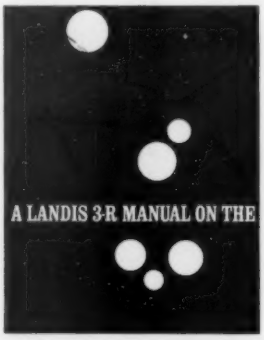
Useful Literature

(continued)

by New England Machine & Tool Co.
Circle 323.

Machining centers vs. multi-spindle machines for NC milling is discussed in a 3-page write-up.
Circle 324.

Machining systems incorporating flexibility through building block design are described in an 8-page brochure by Bendix Machine Tool Corp.
Circle 325.



Rollability of materials is described in a 12-page manual offered by Teledyne Landis Machine.
Circle 326.

Roll die life is discussed in an 8-page brochure.
Circle 327.

How to cut Acme threads is covered in a 12-page brochure.
Circle 328.

Designing the rolled worm thread is discussed in an 8-page brochure.
Circle 329.

NC and CNC turning centers with bar models accommodating shafts up to 72-in. long and chuckers with 28-in. chucking capacity, are described in a 12-page brochure by

American Tool Inc.
Circle 346.

Universal turning centers designed for use with all major control systems, including NC and CNC, are described in a 14-page brochure.
Circle 347.

The American Hustler, a low cost NC turning center, is described in a 12-page brochure.
Circle 348.

(continued on page 64)

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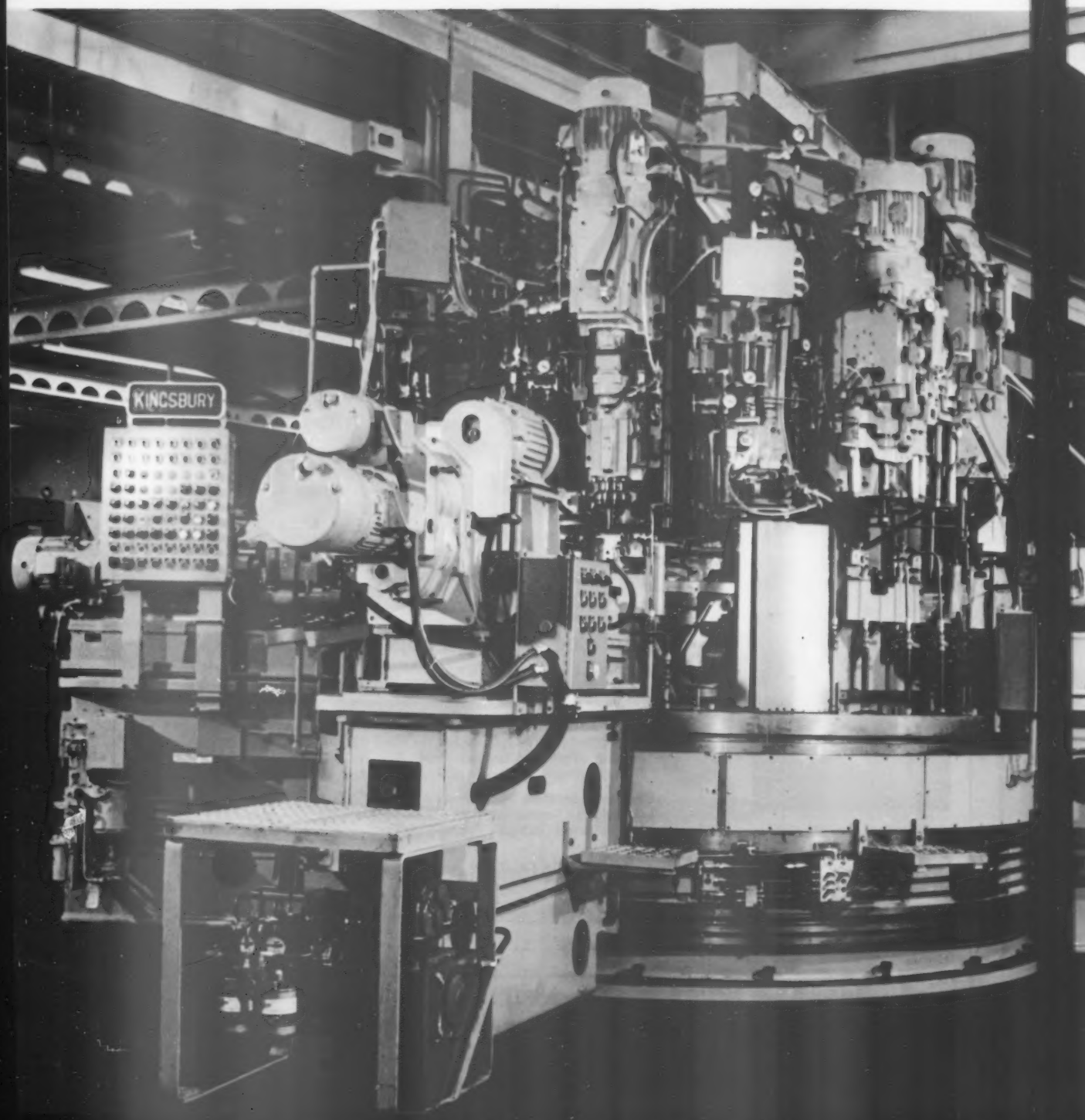
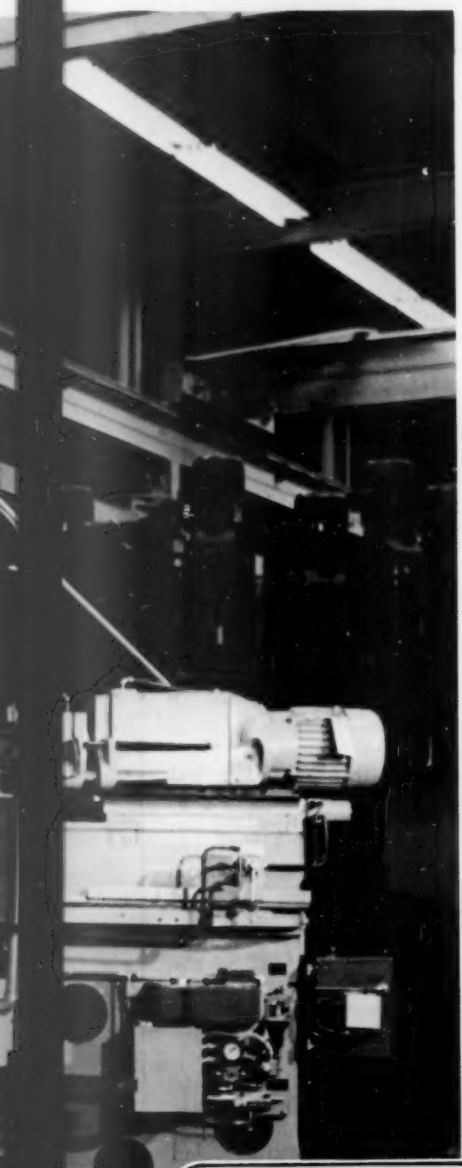


A Kingsbury is a metal parts machining/assembly system that is designed to meet the customer's cost per part, parts per hour, quality of product and predicted payout requirements year after year.



For example:

A car manufacturer needed to machine 180 transmission extensions per hour, meet and maintain a rigid cost-per-part budget and achieve payout on the system in a specific time span. He called Kingsbury.

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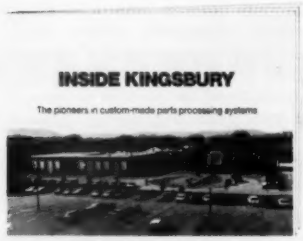
Kingsbury's expertise in solving customer's parts production and assembly problems is yours for the asking. For a closer look at why you should call Kingsbury, write for "Inside Kingsbury". No obligation, of course.



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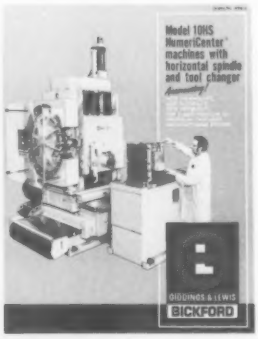
CIRCLE NO. 18 ON READER INQUIRY CARD

Useful Literature

(continued)

Panther NC/CNC turning centers are described in a 16-page brochure.
Circle 349.

A counter centrifugal chuck that maintains higher gripping forces for heavy NC cuts is described in an 8-page brochure offered by SP Manufacturing Corp.
Circle 330.



NumeriCenter machines with horizontal spindle and tool changer are presented in a 12-page brochure offered by Giddings & Lewis, Inc.
Circle 382.

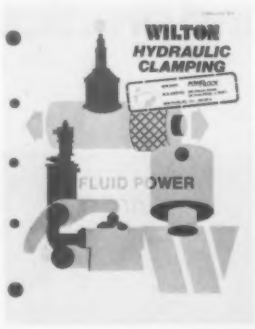
NumeriCenter machines with vertical spindle and tool changer are described in a 20-page brochure.
Circle 383.

Vertical turret lathes and turning centers are described in a 36-page catalog.
Circle 384.

NumeriLathe precision turning centers are described in a literature package containing a brochure and a catalog.
Circle 385.

Table-type production centers are described in a literature package containing catalogs on two models.
Circle 386.

Electrochemical machining and grinding are described in a series of problem-solver case history data sheets available from Chemform.
Circle 332.



Hydraulic clamping is discussed in a guide offered by Wilton Corp. which shows over 30 ways equipment can be used.
Circle 334.

Multiple spindle bar machines for long or short run production are described in a 16-page brochure available from National Acme.
Circle 335.

Acme-Gridley bar automatics, said to be the workhorse of the industry, are described in a 20-page brochure.
Circle 336.

Threading attachments, and how to increase threading profitability on Acme-Gridley bar and chucking machines, is described in a 6-page brochure.
Circle 337.

Acme-Gridley 6-spindle bar machines with 9/16-in. and 1-in. capacity, are de-

(continued on page 69)

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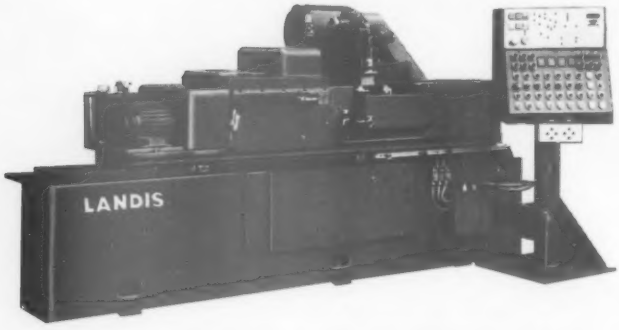

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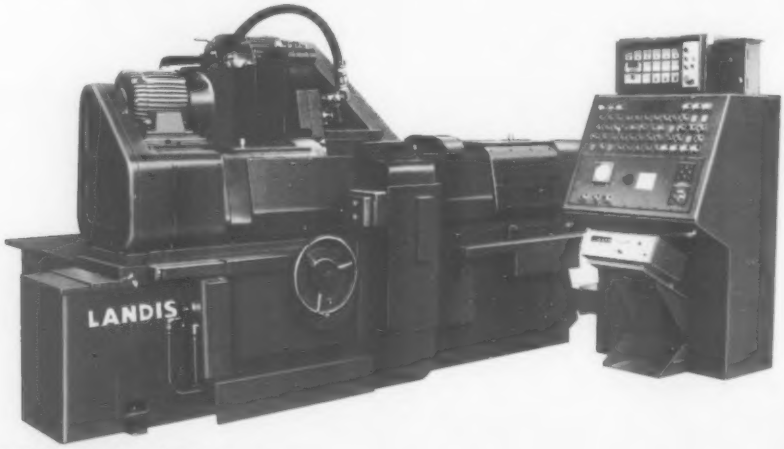

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These Landis grinders with advanced grinding methods . . . engineered to your requirements . . . offer faster cycles, better workpiece quality, more uniform and reliable grinding production.

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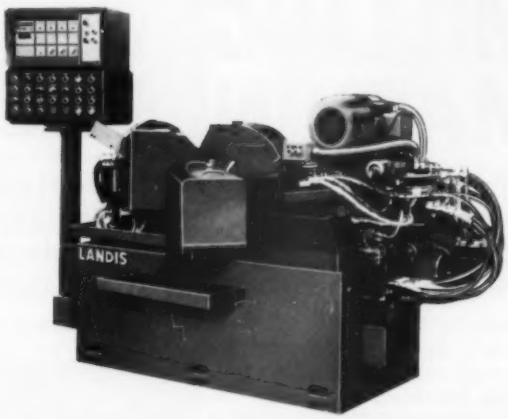
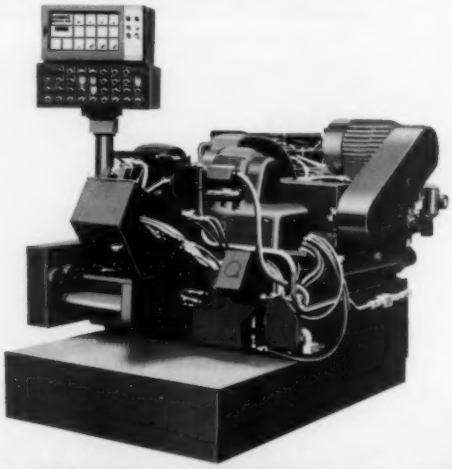
LANDIS UNIVERSAL GRINDERS Available in 29 swing and length combinations. For job lot production and toolroom work.

LANDIS MULTIWHEEL GRINDERS WITH MICROTRONIC FEED Automatically and simultaneously grind multiple in-line diameters on parts such as crankshafts and camshafts.



LANDIS CHUCKING GRINDERS WITH MICROTRONIC FEED Single purpose semi- or fully-automatic machines; for plunge grinding of parts suitable for chucking.



LANDIS PLUNGE GRINDERS WITH MICROTRONIC FEED For production plunge grinding, in one operation, of parts with several diameters, radii, and faces.

LANDIS MICROTRONIC SIZE-CHANGER™ WITH DIGITAL READOUT OF WHEELHEAD POSITION Reduces setup time in grinding either multi-diameter or single diameter parts for profitable small lot operations.

INCLUDING PISTON, VALVE, BEARING RACE, AND ROLL

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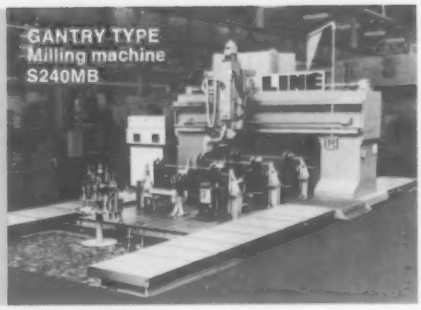
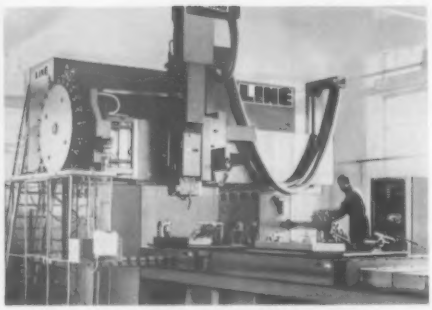
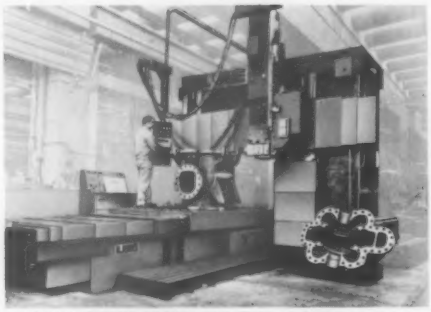




MILLING MACHINE TF-225/NC

A NEW SOURCE FOR HEAVY-DUTY LATHES AND MILLING MACHINES



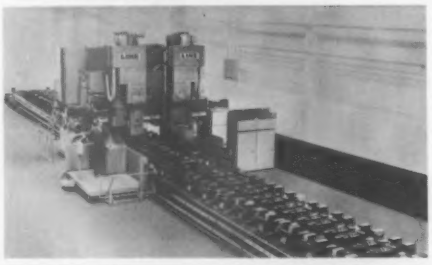
MILLING MACHINE SL220

H.E.S. Machine Tool, Inc. has established a new sales division which offers heavy-duty milling and turning equipment, never before available to the North American market.

Products from **LINÉ**, a company that ranks high among the world's top producers of heavy-duty milling machines are now available through the national sales organization of **H.E.S. Machine Tool, Inc.**

In addition, massive H.E.S. roll turning and turbine lathes will be offered by this new organization of heavy equipment specialists.

Today, these products are in service in many industries:



GANTRY TYPE Rail milling—S216 MB/NC

RAILWAYS
- Track equipment
- Reprofiling of rails
- Bogies for rolling stock

AIRCRAFT INDUSTRY
- Structural panels, spars, frames
- Helicopter blades
- Main parts for landing gears

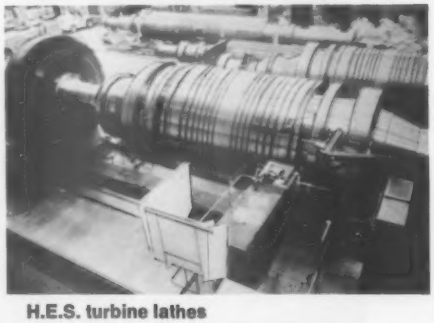
CARS, TRUCKS AND TRACTORS
- Dies for stamping and forging
- Gearbox casings
- Rear axle housings

HEAVY MACHINERY, IRONWORKS
- Medium and heavy diesel engine
- Stands for rolling mills
- Rolls for rolling mills (driving gears)
- Casings for large size reducers
- Ingot scalping

MACHINE BUILDING
- Components of machine tools
- Components of printing machines
- Components of weaving machines
- Components of sugar-works machines

NUCLEAR INDUSTRY
- Vasts and partitions for reactors
- Turbine blades and casings
- Alternator rotors and turbine shafts
- Collectors, heat exchangers and vapor tanks for electric power houses

H.E.S. roll turning lathe



H.E.S. turbine lathes

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H.E.S. MACHINE TOOL, INC.

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CIRCLE NO. 22 ON READER INQUIRY CARD

Useful Literature

(continued)

scribed in an 8-page fold-out.
Circle 338.

Toolholders and attachments for Acme-Gridley 6-spindle bar machines are presented in a 30-page brochure.
Circle 339.

Vertical turret lathes of compact design and with or without numerical controls are described in a 4-page brochure by Schiess Froriep.
Circle 313.

Rotary indexing parts processing systems are described in a 10-page brochure by Kingsbury Machine Tool Corp. It includes typical case histories.
Circle 315.

Parts processing systems of the line indexing, automatic, multi-station type are described in a 10-page brochure.
Circle 316.

Precision spindles for boring, milling, drilling, grinding, and electrolytic grinding are described in a 74-page catalog from Setco. Applications are shown for each of the categories.
Circle 314.

A metalcutting machine for secondary fabrication operations is described in an 8-page brochure from The Bodine Corp.
Circle 390.

The Jigmil technique and how it differs substantially from conventional boring and milling practices is discussed in a 10-page brochure offered by De-Vlieg Machine Co.
Circle 341.

Numerically controlled Jigmils with multi-axis contouring and positioning capability are described in a 16-page brochure.
Circle 342.

The standard series Jigmil with automatic positioning cycle controlled through pushbutton control is described in a 20-page brochure.
Circle 343.

Jigmil machining centers of the horizontal spindle, table-type, are described in a 22-page brochure.
Circle 344.

Jigmil accessories, including index tables and angle blocks, are described in a 16-page brochure.
Circle 345.

Numerically controlled turret lathes in four models ranging from small to mid-size are described in a 20-page brochure offered by Jones & Lamson.
Circle 340.

A four-axis machining center, the smaller size 105 Workcenter, is described in an 8-page brochure available from Ex-Cell-O Corp., Workcenter Div.
Circle 353.

The 108 model NC Workcenter is described in an 8-page brochure.
Circle 354.

Three NC machining centers, the 208, 408, and 508 Workcenter machines, are described in an 8-page brochure.
Circle 355.

A Workcenter designed to handle 12-ton workpieces up to 6 by 6 by 6 ft in size is described in a 4-page brochure.
Circle 356.

A slant bed machine for precision boring, turning, and contouring is described in a 4-page brochure.
Circle 357.

A jig grinder with continuous path numerical control is described in a 42-page applications booklet offered by Moore Special Tool Co., Inc.
Circle 352.

Openside vertical boring mills for boring, facing, and turning are described in an 8-page brochure offered by Farrel Machinery Group.
Circle 359.

Openside vertical boring mills are charted in a 4-page selection guide.
Circle 360.

Vertical boring mills with hydrostatic rams and sad-

(continued)

THIS IS THE PLACE TO BUILD, REBUILD OR N/C RETROFIT YOUR BIGGEST MACHINE TOOLS

At Simmons, no job is too big. Our 150,000 sq. ft. plant and 120 ton crane capacity can take on even the biggest machine tool.

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No problem is too special. We can build the custom machine you need from the ground up, to do your special job.

Tell us what you need and how soon you need it. We'll tell you when you can have it and what it will cos

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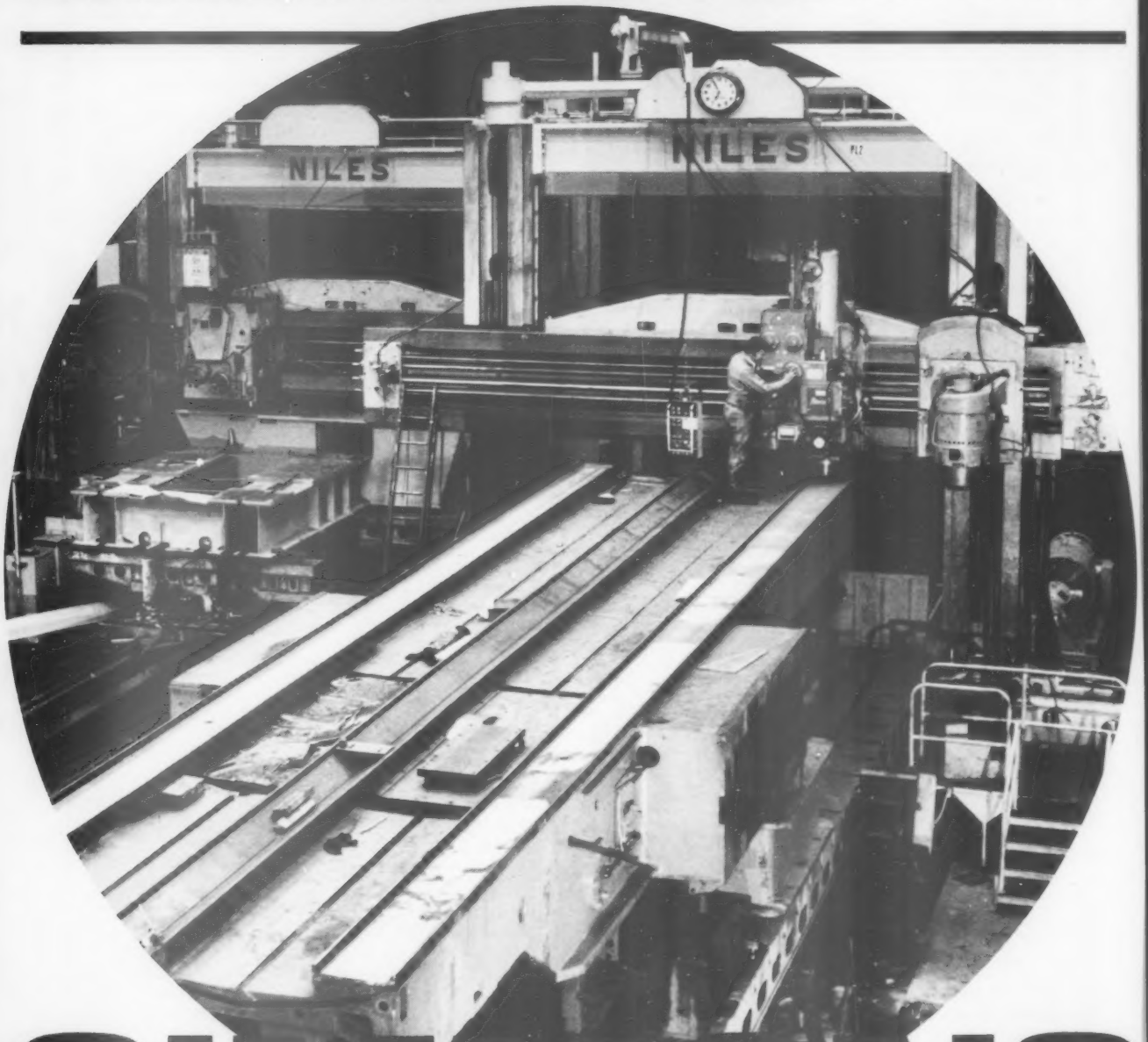
518/462-5431 for full information.



SIMMONS

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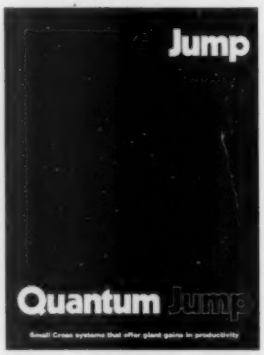
CIRCLE NO. 23 ON READER INQUIRY CARD

Useful Literature

(continued)

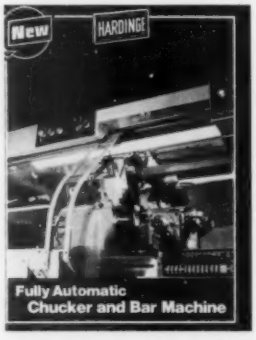
dles are described in a 6-page brochure.
Circle 361.

General purpose lathes are described in a 20-page bulletin.
Circle 362.



How NC machining systems offer giant gains in productivity is described in a 16-page booklet available from Cross Co. It cites seven examples.
Circle 368.

Production machine development over the past 30 years is pictured in a 26-page brochure.
Circle 369.



Its super-precision fully automatic bar and chucking machine is described in a 24-page bulletin offered by Hardinge Brothers, Inc.
Circle 363.

Second operation machines are described in a 24-page brochure.
Circle 364.

A bar and chucking machine designed for NC operation is described in a 4-page brochure.
Circle 365.

A 10-in. toolmaker's lathe is described in a 24-page brochure.
Circle 366.

A tool room lathe with inch/metric dials and dual gear box for threading is described in an 8-page brochure.
Circle 367.

Precision machine tools for milling, drilling, boring, turning, grinding, and gear manufacturing are described in a 12-page brochure offered by Cosa Corp.
Circle 373.

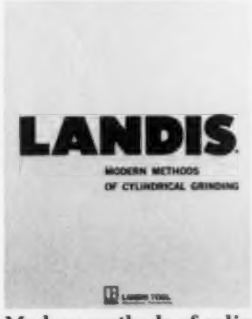
Hydromechanical stroking gear shapers with high productivity and accuracy are described in an 8-page brochure offered by Fellows Corp.
Circle 374.

Index and transfer systems for high speed production operations are described in a 50-page catalog offered by Ferguson Machine Co.
Circle 370.

Formulas for sizing automatic machining units to perform drilling, tapping, reaming, and other metalcutting operations are presented in a 20-page brochure.
Circle 371.

Transfer machine bases with stretch-free segmented steel belt support systems are described in an 8-page brochure.
Circle 372.

Coated abrasive surface grinding is described in an 8-page folder available from 3M. A number of case histories are presented.
Circle 350.

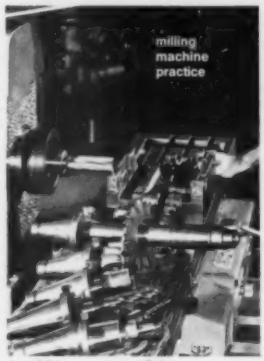


Modern methods of cylindrical grinding are presented in a 28-page brochure available from Landis Tool.
Circle 375.

Angular wheelhead plain grinders with microtronic feed are described in an 8-page brochure.
Circle 376.

Cam contour grinders that rough and finish grind in one loading are described in a 4-page brochure.
Circle 377.

Plain grinders with Microtronic size-changer, for small lot grinding of multi-diameter shafts are described in a 4-page brochure.
Circle 378.



Milling machine practices, including the process and types of cutters and when to apply them, are covered in a 26-page booklet offered by Cincinnati Milacron.
Circle 379.

Cutting gear teeth on a milling machine is described in a 62-page booklet.
Circle 380.

Centerless grinding theory, principles, and applications are described in a 66-page booklet.
Circle 381.

Machining copper metals is described in a 38-page brochure by Anaconda. It includes cutting tool materials, cutting speeds and feeds, and tool rakes and clearance.
Circle 331.

Bendix CBN Gold.

14K results in hogging metal.

Now CBN wheels get out of the past and into your future. Out of the ordinary, too.

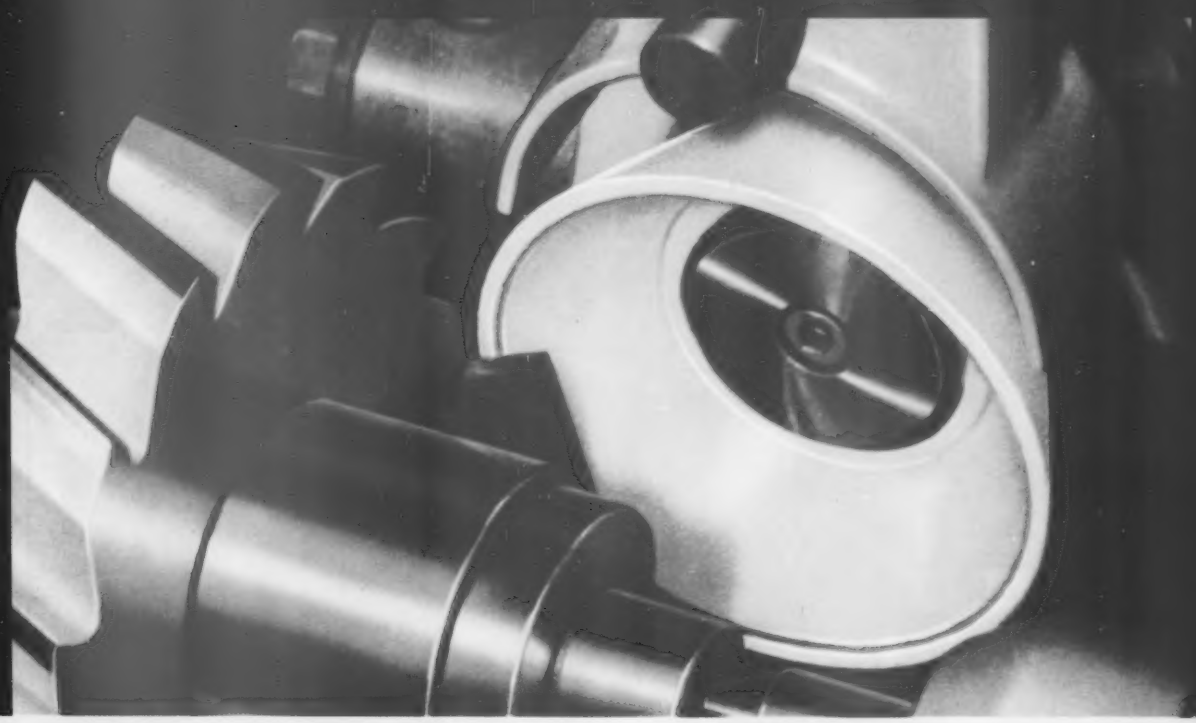
Bendix has done it with CBN Gold—something new and revolutionary in cubic boron nitride wheels.

A new bond beats heat in dry grinding tool steels. Cooler grinding means extended wheel life. And even better still, it means more metal removal per pass—up to .015 in some cases.

Quieter. No burns. Fewer rejects. New grinding rates for what used to be tough jobs. Like tool room regrinding or production grinding of high-speed steel milling cutters, end mills, reamers and other tools.

If you want 14K results like these in your tool room or production job, contact Bendix. Ask for a test. You'll find out more about how Bendix CBN Gold can help stake a claim to higher metal-removal rates. The Bendix Corporation, Abrasives Division, 2917 Wildwood Avenue, Jackson, Michigan 49204.

Bendix



We speak your language.

CIRCLE NO. 24 ON READER INQUIRY CARD

Planning for Cost Effective Drilling

Though high technology for making holes has been developed, and the use of the laser, electron beam, EDM, and ECM for this purpose has proliferated, conventional drilling techniques still are the backbone of production holemaking operations. But changes have been made in the traditional design and construction of the cutting tools used with these techniques to make them more cost effective. Here are some examples of the tools and techniques which should be considered when planning drilling operations

One industry expert estimates that 80 percent of the metal removal dollar goes to make holes; another hazards that, in dollar value, twist drills and spade drills account for one fifth of all metalcutting tools.

Although both estimates may be exaggerations, they suggest we ought to stop taking production drilling operations so much for granted and begin to apply the cutting tool technology that is available.

Generally speaking, two of the bigger problems in production drilling are the dissipation of heat and getting the chips out of the hole. To alleviate these problems, a number of twist drill manufacturers have taken different routes in modifying the basic two flute, single margin twist drill to better suit it to production drilling applications.

General Chipbreaker Drill Co., Cicero, IL, for example, offers a twist drill design which has a special patented chipbreaker rib precision milled along the full length of the flutes. The cutting action is said to be the same as that of a standard drill with the cut being made the full length of the cutting edge and the chips sliding down the face of the flutes. Contact with the chipbreaker rib breaks the material into short "figure 6" chips which are easily ejected through the flutes.

Breaking the chips into small curls means better chip clearing and improved coolant flow so that freer cutting with heavier feeds at slower spindle speeds can be achieved. The drills have full-length constant web thickness and can be resharpened on standard drill pointing equipment. They're available in all sizes and lengths in both standard and oil tube configurations.

Bendix Industrial Tools Div. takes a somewhat different approach with its Bendix Besly "Turboflute" twist drills. These drills are distinguished by a split point and a parabolic flute profile—features said to produce short chips which pass out of the hole without clogging, deliver more coolant to the drill point, and often make woodpeckering un-

Parabolic profile of "Turboflute" twist drill is said to improve coolant flow and provide better chip flushing

CHECKLIST

Factors to consider before installing coolant-fed tooling:

1. **Is tool geometry correct?**
2. **Is fixturing rigid?**
3. **Does fixturing permit ease of chip flow?**
4. **Is machine horsepower sufficient?**
5. **Can adequate feeds and speeds be obtained?**
6. **Is coolant system adequate (volume and pressure)?**
7. **Is coolant filtering system adequate?**
8. **Will richer coolant mixture be required (lubricity)?**
9. **Will an anti-foaming additive be needed?**
10. **Is splash protection needed?**

necessary in deep hole drilling operations. Deep holes up to 12 or more times drill diameter can be produced in one pass, it is claimed, with penetration rates up to 100 percent faster than conventional drills.

Two styles in most sizes and lengths are offered. Style HD (heavy duty) is intended for drilling stringy, low and medium strength steels below 120,000 psi ultimate tensile strength and for drilling nonferrous materials. Style XHD (extra heavy duty) is designed for drilling short chip materials such as the higher strength steels and iron castings.

Combine Operations. Obviously, the objective of all manufacturers of production hole drilling tools is to design a tool that somehow increases efficiency and productivity of the operation. And Mohawk Tools, Inc., Montpelier, OH, long ago recognized that a drill which could generate two or more diameters in a single pass would win acceptance in production shops.

Today, though the company manufactures and markets all kinds of drills, core drills, reamers, and so forth, it is perhaps best known for its subland drills. These drills differ from step drills in that the step drill is a conventional two flute drill with a second diameter created by grinding down a portion of the larger diameter while the subland drill is actually two (or three) two-flute drills combined into one tool but retaining the characteristics and proper geometry of each. Since each diameter of the subland drill has its own independent flutes and margins, size of the small diameters and concentricity between diameters is ensured throughout the life of the tool and are not affected by resharpening of point or step angles.

Both step and subland drills can be used to combine such operations as drill and drill (two diameters), drill and chamfer, or drill and counterbore. Additionally, Mohawk also manufactures and markets a "2-2-2" subland drill which can be used to combine three operations such as drill, c'bore, and c'sink; drill, c'bore, and c'bore; or drill, drill, and spotface.

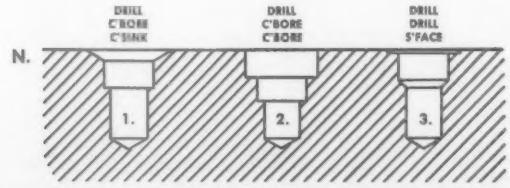
Mohawk also lists multi-margin twist drills in its product line. The use of double and triple margin drills is said to provide greatly increased support in guide bushing or hole cavity making possible closer control of diameters.

Heavier Feed Through Stubbing. To achieve longer drill life and more metalcutting efficiency, most twist drill manufacturers advocate the use of the heaviest feeds and slowest speeds possible. But to use heavy feeds, the drilling tool must have a high degree of rigidity, and the ratio of diameter to length of standard drill (particularly those ½ in. OD and under) makes them unsuitable for heavy feeding. Erickson Tool Co., Solon, OH, suggests "stubbing" these drills by using Erickson collet chucks to grip the drill securely with only the minimum needed length protruding.

Other than the heavier feeds possible, Erickson claims increases usually amount to 25-50 percent, collet chucks permit the use of straight shank instead of more expensive taper shank drills, reduce the chance of breakage, and extend drill life since concentricity of cutting edges is improved when angular error—caused by length of projection—is reduced.

Increasing Coolant Effectiveness. Flood application of coolant, though the most common and

Mohawk "2-2-2" subland drill is three two-flute drills of different diameters combined. Independent flutes and margins guarantee size relationship and concentricity for life of drill. It may be used to combine operations as shown below



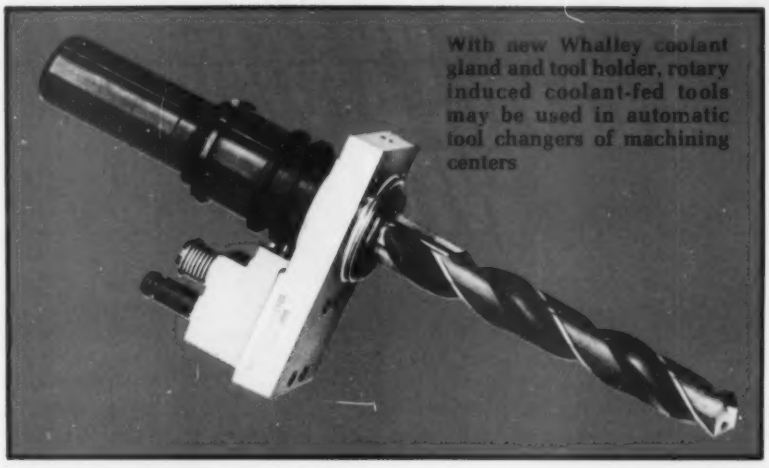
convenient method, is not the best way to cool and lubricate the cutting edges of drilling tools. Except for small diameter (under ⅛ in.) and very shallow holes, a more effective way is to apply coolant under pressure through oil holes in the drill shank and body which exit at the drill point.

Howard M. Whalley of the George Whalley Co., Cleveland manufacturer of many types of coolant-fed tools, lists the advantages of coolant-fed drills as:

1. Reduction of friction on cutting edges,
2. Increased feed and speed due to better heat dissipation,
3. Increased tool life,
4. Flushing action eliminates recutting of chips,
5. Improved finish,
6. Improved accuracy,
7. Reduction of horsepower required, and
8. Elimination of smoke due to friction heat.

These coolant-fed or oil-hole drills have been around for a long time, and though their use generally has been limited to deep hole or extremely difficult drilling jobs, lately there has been renewed interest in them for more routine drilling applications. For example, NC machining centers of all types are now available with coolant-through-the-spindle systems and high volume-high pressure coolant pumping systems. And there are a number of commercially available pumping systems that have been developed for use with rotating collar assemblies.

One recent Whalley Co. development of interest to users of Kearney & Trecker Milwaukee-Matic 200 and 300 machining centers is a retrofit kit which facilitates the use of coolant-fed tooling. Consisting of the straight shank holder patented by K&T—which Whalley is now licensed to manufacture—and a specially designed, double sealed coolant gland, the package permits coolant-fed tooling to be used in the automatic tool changers of these K&T models.



With new Whalley coolant gland and tool holder, rotary induced coolant-fed tools may be used in automatic tool changers of machining centers

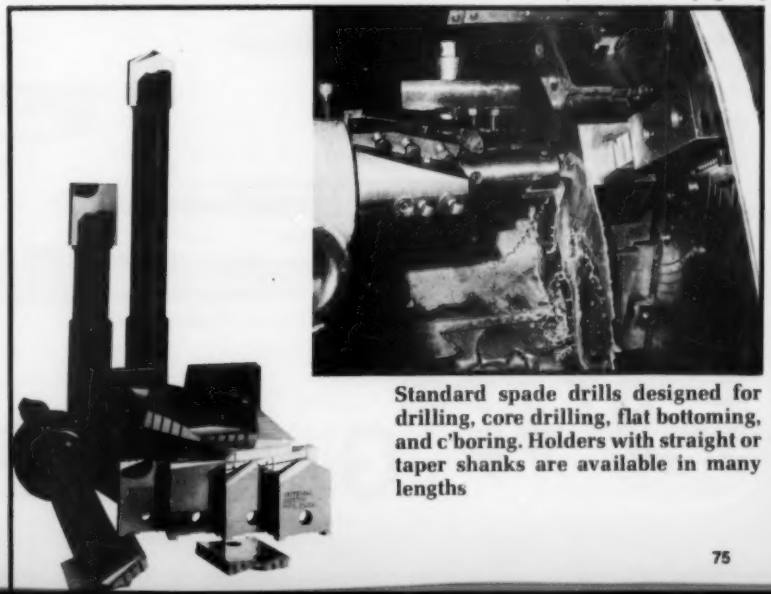
Making Holes with Spade Drills. Spade drilling is not a new development in holemaking, but it is a method that must be thoroughly understood and properly applied if the user is to fully realize its productivity improving potential. Commenting on the "hows and whys" of spade drill use, Walter Baturka, president, Universal Houdaille, Frankenmuth, MI, has this to say: "Ask a shop foreman, manufacturing engineer, or machine operator to list cutting tools according to how much they know or understand about them, and I'm willing to bet that spade drills would be well down the list—if they showed up at all. And yet spade drills possess great potential for cost reduction and productivity improvement wherever large (1½ in. or more in diameter) and deep holes are being produced.

"As compared to twist drills, ejector drills, or trepanning tools, spade drills:

1. Produce holes of comparable diameter accuracies, better straightness, and somewhat worse finish (they are not recommended for finishing work),
2. Reduce cutting cycle time significantly,
3. Are easily maintained 'in-house' even with unskilled personnel, and
4. Cost less to both purchase and maintain.

"Satisfactory spade drill performance is greatly dependent on use of speeds and feeds vastly different from what is considered

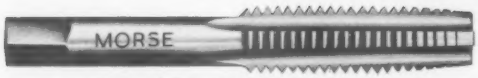
(continued on page 77)



Standard spade drills designed for drilling, core drilling, flat bottoming, and c'boring. Holders with straight or taper shanks are available in many lengths

IT'S HOW YOU FINISH THAT COUNTS... AND YOU ALWAYS FINISH FIRST WITH MORSE TAPS!

Richard Petty,
all-time leading stock car race driver,
driving an STP Dodge.

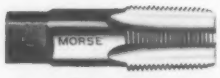


General-Purpose Hand Taps

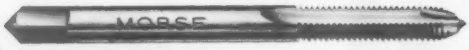
Helical Fluted Taps

Informer Taps

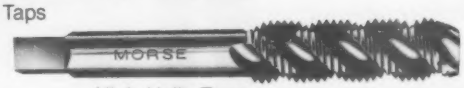
Pulley Taps and Nut Taps



Pipe Taps



Spiral Point Taps



High Helix Taps

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MORSE TAP SELECTOR GUIDE

To help you select the right Tap for the right job use this handy pocket-size guide. Send for your copy today.

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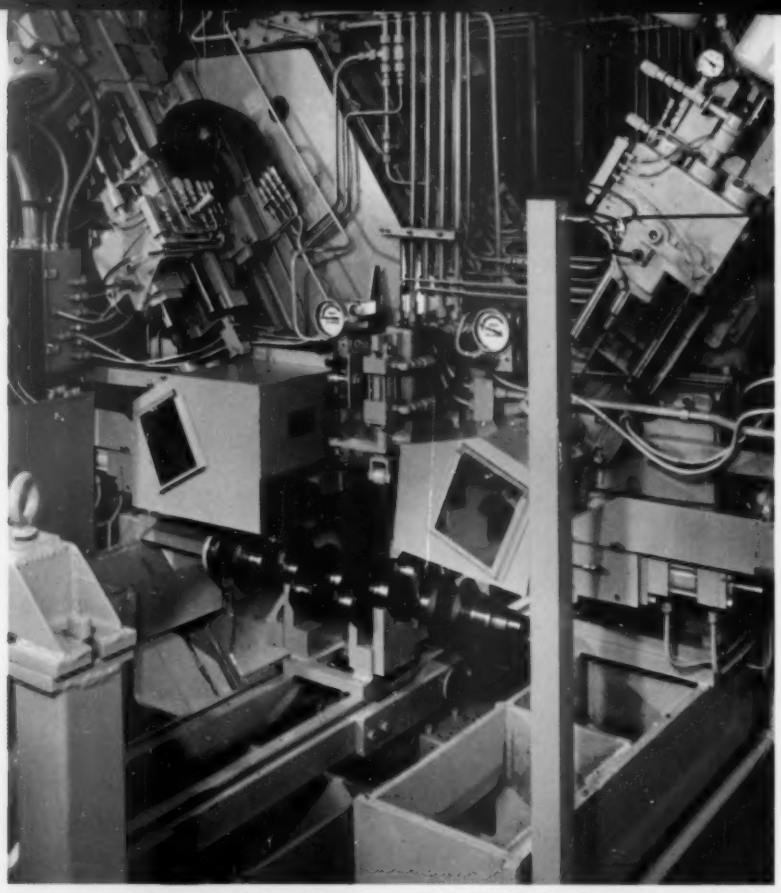
THE RIGHT HAND OF PRODUCTION

G+W **Morse® Cutting Tools Division**
Gulf + Western Manufacturing Company
(Eastern Group)
P.O. Box F923, New Bedford, Massachusetts 02742 U.S.A.

CIRCLE NO. 60 ON READER INQUIRY CARD.



Carbide tipped gundrills applied to crankshaft oil hole drilling on new 12-station Cross transfer machine make three times as many parts between changes as twist drills; reduced downtime means improved overall efficiency

(continued)

good twist drill practice. Spade drills are run at speeds about 20 percent slower, with feeds 150 to 200 percent greater. They have another advantage over twist drills in that, once the blade begins to 'bite' the workpiece, it is relatively free of chatter despite the high feed rate.

"Some spade drilling tips:

1. Do not hand-feed . . . always use power feed.

2. When drilling a vertical hole, always use through-the-holder coolant.

3. For vertical holes, more than 2 diameters deep, stop the operation after each half-diameter of penetration to remove chips.

4. If the hole is more than 2 diameters deep, use a drill bushing, or use a short holder to start the hole and drill about 1 diameter deep.

5. If a vertical hole is more than 10 diameters deep, drill first with a smaller oil-hole twist drill, then open it up with a core blade of high speed steel or carbide.

6. On radial drills, keep the work as close as possible to the column. Where the spindle must be more than one-third of the way out on the radial arm, use tie-downs to avoid deflection, and use recommended feed rates.

7. Make sure the machine used for spade drilling is a rigid one.

8. Do not start a spade drill using a centerdrill or small lead hole as in conventional drilling, because these methods leave a sharp edge which may damage the spade drill edge.

9. If the machine lacks sufficient horsepower or thrust for spade drilling the desired final hole diameter from the solid, predrill at ½ to ⅔ the final hole diameter.

10. If the surface to be drilled slopes more than a few degrees off the perpendicular to the spade drill axis, machine a flat at least as wide as the hole diameter.

"Spade drills are easy to maintain with the right blade sharpening fixture. Setting up a spade drill program in a shop is simpler and less costly than any other method for producing large holes. In most shops, spade drills represent an untapped gold mine of opportunity. Properly selected, applied, and maintained, they can provide significantly increased metal removal rates at less tool cost. In other words, they are an easy means for improving profitability."

Growing Applications of Gundrills. It's taken a lot of missionary work to get the gundrill out of the gun shop and into the production manufacturing plants where it also belongs. Once thought to be limited to the making of straight deep holes, gundrilling now is an accepted high production process and has brought its special capabilities to the making of holes in all manner of parts—be they wide, narrow, short, long, metallic, or nonmetallic.

Eldorado Tool & Manufacturing Corp., Milford, CT, perhaps the largest and best known manufacturer of gundrills and gundrilling machines in the nation, recently reported that, five years ago, the typical gundrilled hole was 10 to 12 in. deep. Today, it says, the average depth is 4 in. and holes 1 to 1½ in. deep are not uncommon. Also, a trend has been noted toward smaller diameter holes. About 85 percent of applications now involve hole diameters of ½ in. or less, and .078 in. diameter holes are in daily production, the company says. (5/64 in. is smallest Eldorado stock size; largest is 1½ in.)

Application engineers at Eldorado Tool advise that one shouldn't adopt gundrilling if an ordinary twist drill will do the job; but where tolerances, geometry, finish, or materials cause production problems, gundrilling should be considered.

Though machines and tooling for production gundrilling opera-

(continued on page 81)

Be choosey.

850 styles and sizes available to boost your milling productivity.

Proper cutter selection can make the difference between milling productively, and just "making chips." That's why we've developed the broadest line of milling cutters in the industry. To make sure we can apply the proper cutter to your particular job.

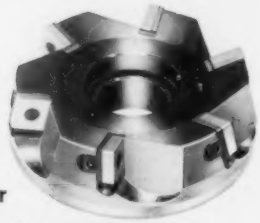
With Kennametal cutters you'll also have fewer dollars tied up in parts inventory. Simplicity of cutter design means *fewer* parts, and these are *interchangeable*. Combine this with an ability to get good finishes using economy inserts in a variety of carbide grades designed specifically for milling, and you have a cutter that can save you money while increasing productivity.

Check the features of the variety of cutters below:

Reduced Setup Time

K-Mill® cutters

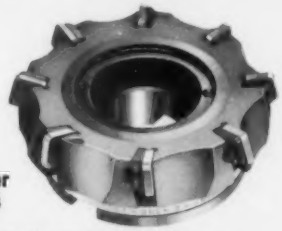
- qualified to ± .003
- shear angle geometries reduce horsepower consumption
- 35 styles and sizes available
- high positive geometries available



Use Less Power

Kenloc® utility cutters

- use N/P® inserts — so you can change rake by just changing inserts
- reduce power consumption, too
- 22 styles and sizes available
- require only 3 spare parts



Fewer Parts

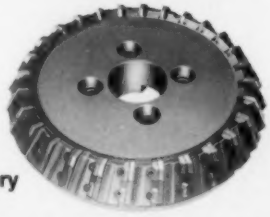
Kenset™ pre-set cutters

- only two parts per pocket — wedge and screw
- 346 styles and sizes available
- utilize ½" or ¾" inserts
- ground body accepts setting plate

346 Styles & Sizes

Kendex® factory set cutters

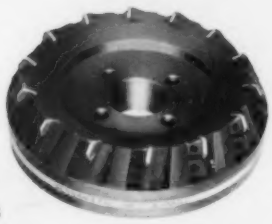
- wedges and nests interchangeable within styles and sizes
- 346 styles and sizes available
- utilize ½" or ¾" inserts
- ground body accepts setting plate



Low Inventory Cost

Kenset and Kendex fine pitch cutters

- common, interchangeable hardware
- uses a variey of insert geometries
- 220 styles and sizes available
- high performance



High Chip Loads

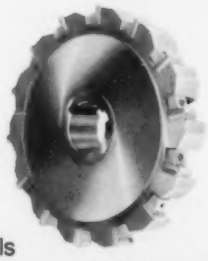
heavy duty shear angle cutters

- nest positions inserts and acts as a chip deflector
- maximum depth of cut with high feeds
- utilize ¾" or 1" inserts

Slot ¼ Inch

slotting cutters

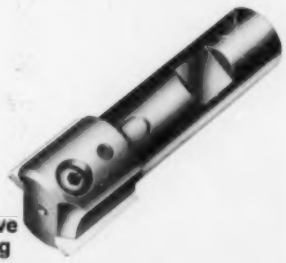
- ¼", 5/16" and ⅜" wide cutters available
- also available in ½", and ¾" and 1" widths
- staggered cutting on all 22 styles
- positive insert location and locking
- double positive rakes



Fast Indexing

half side mills

- interchangeable nests accept triangle or square inserts
- positive cutting action reduces horsepower consumption
- 0° or 3° lead angles



Positive Cutting

two-bladed end mills

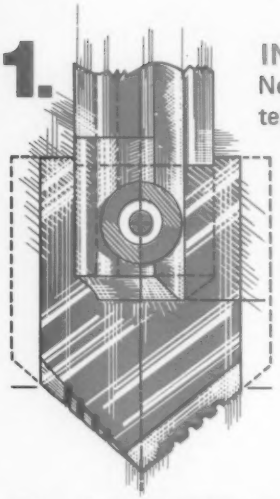
- positive radial rake
- use 1" long standard indexable inserts
- 0° lead angle

Ask your Kennametal Tooling Professional to recommend and demonstrate a milling cutter for one of your operations. He will show you how proper cutter selection and application can increase your milling productivity and save you money. Contact Kennametal Inc., P.O. Box 346, Latrobe, PA 15650. Phone 412-537-3311.

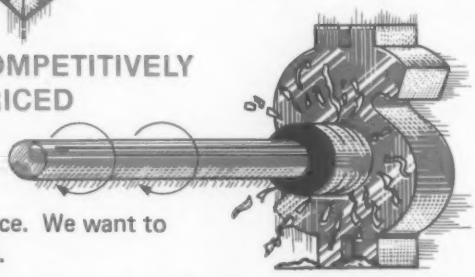
KENNAMETAL®

CIRCLE NO. 25 ON READER INQUIRY CARD

Six good reasons why you should buy our spade blades and holders now.

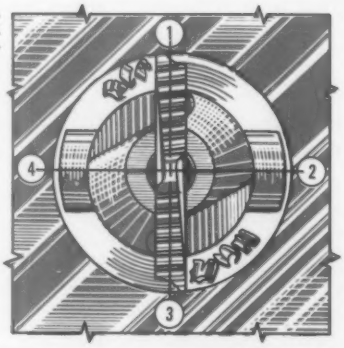


1. INCREASED RANGE
New oversized blades extend cutting range of each holder.
Results:
- Fewer holders required.
- Oversized blades cost less than larger series standard blade.
- Provide more chip clearance on low side of range.



2. COMPETITIVELY PRICED
Compare our price in the marketplace. We want to sell blades.

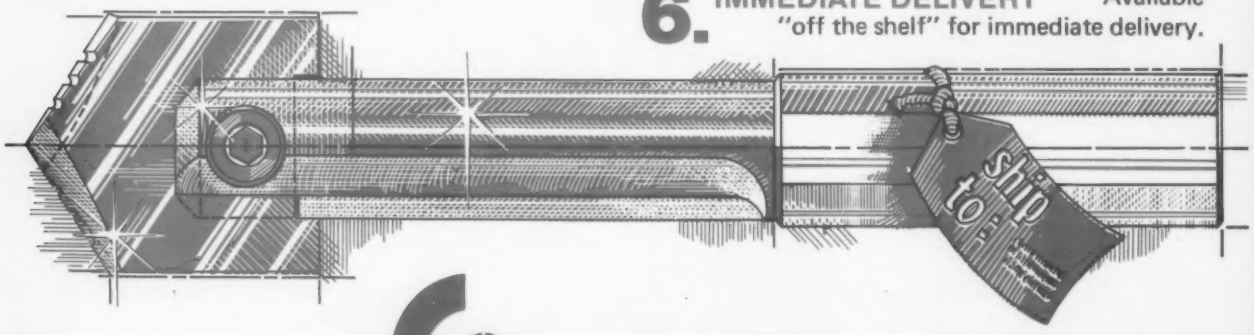
3. FINEST QUALITY Every blade manufactured from finest quality material and 100% inspected for hardness and dimension. Magnifluxed to detect imperfections.



4. EXCLUSIVE WEAR STUDS
Located up front where they belong to give four points of contact. Unlike conventional spade drilling where only two points are in contact when breaking through, we've designed our holders with patented, interchangeable up-front wear studs. The high rigidity that results permits maximum feed rates to match optimum drilling rates. And four-point support puts an end to vibration, chatter, blade chipping and dulling during drilling and breakthrough.

5. RUGGED CUTTING EDGE 12° top rake permits maximum feed rates . . . lengthens blade life . . . gives more holes per grind.

6. IMMEDIATE DELIVERY Available "off the shelf" for immediate delivery.



erickson tool company

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CIRCLE NO. 26 ON READER INQUIRY CARD

(continued)
tions are much more expensive than twist drilling equipment, the process offers special advantages in the way of reducing piece part costs. Scrap, for example, is negligible due to gundrilling's ability to repeatedly produce accurately sized and located holes with excellent roundness, straightness, and other geometric characteristics. Gundrilling also can produce surfaces as fine as 10 micros or better, depending on material, so that secondary finishing operations such as reaming and boring often are unnecessary.

The process also causes minimum workhardening and may eliminate the need for annealing and other corrective operations. Penetration rates at higher speeds and lower feed rates are substantially higher than for twist drills, and, because of its deep hole drilling ability, the imaginative manufacturing engineer often can find ways to gundrill several parts at once by stacking or otherwise arranging and fixturing similar parts.

Unlike some of the other types of drills, carbide tips are used on gundrills to drill almost all types of materials.

An example of how gundrilling now is being adapted to highly automated, high volume production jobs is a new multi-station transfer machine built by Cross Co., Fraser, MI. This new machine utilizes carbide tipped gundrills to produce 12 quarter-in. diameter angular oil holes in 1045 steel crankshaft forgings for six-cylinder engines.

General practice in the industry has been to use twist drills with peck-feed units to drill these 7:1 ratio (length to diameter) holes. The gundrills, however, machine the holes in a single pass and achieve triple the tool life of twist drills. Consequently, downtime for tool changing is reduced considerably and an increase in overall efficiency is achieved.

BTA and Ejector Systems. Developed during World War II in Germany and subsequently promoted throughout the world by an international group of industrial companies is the BTA (Boring and Trepanning Association) system for drilling large diameter deep holes. In this system, a cutting head is used which has a large internal passageway, one or more carbide inserts brazed across its cutting face, and carbide bearing strips located lengthwise on its periphery. Its shank end is threaded for joining to a hollow tube which serves as a shank extension or drill body.

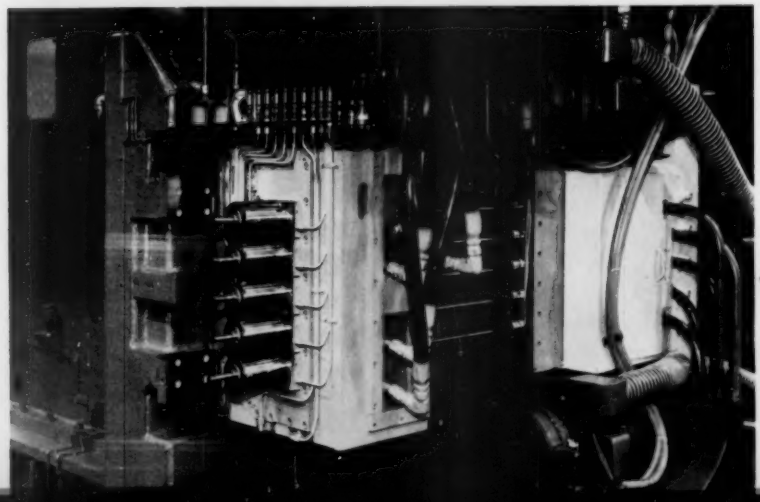
In use, the head operates within a bushing and seal which is forced tightly against the workpiece. A high pressure system forces the flow of coolant through the bushing and between the head OD and bushing ID via the relief provided by the bearing strips. Chips and coolant thus are forced to flow back through the internal passageway and out the tubular drill body.

The BTA system is capable of high metal removal rates and of producing close tolerance deep holes with good surface finish. Tool maintenance (number of sharpenings possible) and upkeep of seals are reported to be the only drawbacks of the system. (More information on the BTA system can be obtained from American Heller Corp., Detroit, MI)

Another drilling system, capable of high production drilling of holes .072 in. to 2.600 in. diameter, is Sandvik's "Ejector" system. This system is similar to the BTA system except that two tubes—an inner and an outer tube—make up the drill body. The space between the two tubes allows the flow of fresh coolant to the cutting head. An annular nozzle at the end of the inner tube directs some of the coolant back through this tube thus creating a partial vacuum which aids in the exhaust of chips and spent coolant back through the drill body.

Pages 60 and 61 of PRODUCTION's Manufacturing PLANBOOK: 1977 carried a description and illustrations of the Ejector drilling systems manufactured by Sandvik, Inc., Coromant Div., Fairlawn, NJ. Since then, the company has continued to improve the design and construction of these highly efficient holemakers. Notable improvements are form-sintered chipbreakers which need not be ground, thus assuring more consistently correct chipbreaking, and a change in tip edge geometry which has broadened the range of materials that can be successfully machined with these tools.

While this discussion of some of the different tools and techniques that can be applied to drilling is necessarily brief, it is hoped that the manufacturing engineer will find it to be of some assistance in planning for more cost effective drilling operations. *CH* □



BTA tools in the five spindles of this specially built Cross machine are said to drill tube sheets at 1½ to 2 times the feed rate of gundrills. Coolant system delivers 50 gpm to each spindle at pressures to 1000 psi

Useful Literature

PERISHABLE TOOLS

Special application tools, including diamond-edge band tools and spring-tempered blades, are described in a 16-page brochure offered by DoAll Co.
Circle 401.

High-speed steel band saw blades are described in a 12-page brochure.
Circle 402.

Carbon steel band saw blades are described in a 14-page brochure.
Circle 403.

The method for selecting the cutting or grinding fluid best suited to specific metals and machining operations is described in a 6-page brochure.
Circle 404.

A tool steel comparison chart is presented in a 6-page brochure.
Circle 405.

Carbide grade selection, speeds and feeds charts, milling formulas, and information on drilling and tapping are included in a pocket-size handy reference booklet offered by Valenite Div.
Circle 418.

Reference data for metal-cutting shop use is presented in a 25 in. by 38 in. wall chart.
Circle 419.

Double-edged boring and finishing tools, cutting systems, and combination tools are described in a 20-page bulletin available from Madison Industries.
Circle 413.

Spade drills and their applications are described in a 12-page brochure.
Circle 414.

Burnishing tools and the advantages of the burnishing process are described in a 32-page bulletin.
Circle 415.

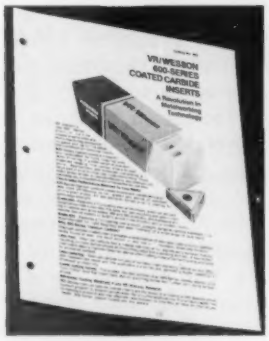
A grinding wheel cost analysis package, including a grinding cost sav-

Get the edge on every milling operation. Sandvik Coromant.

Sandvik Coromant, the world leader in milling cutters, produces the right milling cutters and inserts for every operation. For highest product quality, improved productivity, and lower machining costs, take advantage of the Sandvik edge.

Our world-renowned technological expertise and sales engineering assistance assure you the most cost effective milling operations possible.

ings form and a brochure explaining how to use it, is available from Cincinnati Milacron.
Circle 435.



A line of titanium coated inserts featuring a premium-alloyed tungsten carbide substrate is described in a 10-page brochure available from VR/Wesson.
Circle 406.

Selection and application of carbide metal removal tooling, and analyzing tool life and insert failures, are described in an 82-page handbook available from Carboloy Systems.
Circle 408.
Deep grooving and cutoff tooling, with a guide to carbide grade selection, are described in an 8-page brochure.
Circle 409.

Carbide milling inserts for all popular cutter bodies are described in a 16-page brochure.
Circle 410.
What coated carbide is all about is described in a 12-page booklet.
Circle 411.
Carbide threading and grooving tooling is described in a 32-page catalog.
Circle 412.

Standardization of NC tooling for greater productivity is covered in a 20-page reprint of a technical paper available from Kennametal Inc.
Circle 441.
Tooling packages for NC machining centers are described in a 32-page brochure.
Circle 442.
Drills using indexable carbide inserts are listed and described in a 4-page brochure.
Circle 443.

Band and hacksaw blades are described in a 20-page technical manual offered by Simonds Cutting Tools.
Circle 438.
Solid circular metal saws are described in a 12-page technical manual.
Circle 439.

(continued)

We'll even survey your present machining operations and recommend ways for you to get more for every milling dollar you spend.
For more information, call the Sandvik Coromant office nearest you.
Coromant Division, Sandvik, Inc.,
1702 Nevins Road, Fair Lawn, NJ 07410.
(201) 797-6200.

SANDVIK Coromant

CIRCLE NO. 27

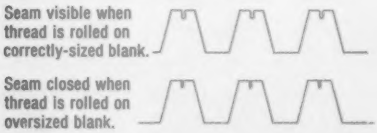
When should you roll threads and when should you cut threads?

The right answer could save you thousands of dollars every year.

As it did for an auto-jack manufacturer who read an article in Thread Tips, our house magazine, and thought he might save by rolling instead of cutting. We analyzed his situation and agreed. He switched and recouped the cost of conversion in two months.

We'll do the same kind of analysis for you—completely unbiased, because we sell the machines and tooling for both methods. Some of the things we'll look at:

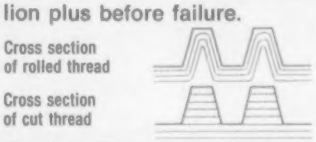
Material—Cutting can be applied to a wide range of ferrous and nonferrous metals—even to wood and plastics. Rolling is generally applied to metals with an elongation factor of 12% or better. When materials with less than 12% elongation are rolled, effectiveness is reduced unless warm or hot rolling techniques are employed.



Workpiece—Blank tolerances must be tightly controlled for rolling because the process deforms metal into a die rather than cutting it away. Cutting permits the use of oversize blanks, at the expense of greater material waste.

Volume—In short runs, cutting is less expensive than rolling because chasers cost less than rolling dies, die head setup is easier, and blank preparation is simpler. As runs get longer, rolling becomes increasingly profitable in several ways: It is much faster (up to 50 times). Less material is required because blank diameters are smaller. Production need never be interrupted for resizing or checking finish because these factors remain constant for the life of the dies.

Original Tooling and Tool Life—Threading tools, both cutting and rolling, are relatively inexpensive and can be used on many kinds of machines. In comparing the two, the lower-cost chasers used for cutting have greater latitude of application and can be reground to minimize direct expenditures for tooling. Rolling dies generally cannot be reground and their use is more feasible for long run work. A rolling die set will produce tens of thousands of parts—in some instances, a million plus before failure.



Quality—Threads of superior quality are not required for every job. However, when peak quality is necessary, rolling reforms or flows the grain structure along the cross-sectional contour of the threads to give them optimum shear strength. Rolling also cold works the material to improve its hardness and tensile strength. Hardness of a 20-22RC steel can be improved by as much as 8 to 10 points.

Adaptability — Threading machines and tools should mesh with overall production needs. In choosing a threading method—cutting or rolling—for any job, all current and future work should be considered.

Your Landis representative has the experience to give you objective on-the-spot assistance in deciding *which* threading method to use *when*. He'll weigh all of the factors outlined here . . . plus many more. He'll also recommend the tooling and/or machine for implementing the method selected to best advantage. When you put it up to Landis, you can count on receiving a *complete* threading answer.

TELEDYNE
LANDIS MACHINE

5th and Church Streets,
Waynesboro, Pennsylvania 17268.

Literature and tips on Acme and other types of threads from Teledyne Landis Machine

CUTTING EXTERNAL THREADS:

How to Cut Acme Threads — 12-page bulletin covers all aspects of Acme threads.

Circle No. 175

TAPPING THREADS:

Tips for Solving Tapping Ills — 8-page article on the correct ways to use collapsible taps.

Circle No. 176

ROLLING THREADS:

Rollability of Materials — 12-page bulletin on the effects of cold-working various metals.

Circle No. 177

HOLLOW MILLING:

Reference Manual on Hollow Milling — 8-page bulletin on the use of Landis threading equipment for forming, turning, pointing, grooving and facing operations.

Circle No. 178

THREADING & FORMING:

Update: Metric Threading — 8-page progress report on the status of metric threading...conversion of existing tooling to metric.

Circle No. 179

General Bulletin — 12-page bulletin on full line of Landis machines and tools for cutting, tapping and rolling.

Circle No. 180

Thread Data Handbook, 13th Edition — 230-page book of helpful information and reference data on Landis equipment for thread cutting and thread rolling (English and metric), plus general thread data charts on UN, Whitworth and metric. $3.00, including postage and handling. Check must be sent with order direct to Teledyne Landis Machine, Att'n: Reader Service Dept.

Useful Literature

(continued)

Facts on files, and helpful tips and proper filing techniques, are presented in a 36-page pocket-size booklet.
Circle 440.

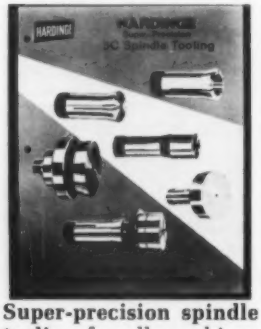
Hot pressed abrasive cut-off wheels providing long lasting service in foundry applications are described in a 4-page brochure available from Acco.
Circle 448.

Deep hole drills capable of drilling hole depths up to 12 times their diameter are described in an 8-page catalog by Bendix Industrial Tools Div.
Circle 449.

Guhring drills for drilling depths to 15x hole diameter in a single pass without woodpeckering are described in a 16-page brochure offered by Custom Products Corp.
Circle 450.

Drills for drilling titanium and other hard-to-machine metals are described in a 6-page brochure.
Circle 451.

Micro-precision drills for holes as small as .002 are described in a 4-page brochure.
Circle 452.



Super-precision spindle tooling for all machines and attachments with a 5C spindle are described in a 12-page brochure offered by Hardinge Collet Div.
Circle 453.

Turret tools and tool holders are described in an 8-page brochure.
Circle 454.

Carbide cutting tools for lathes, chucking machines, and automatics are described in a 32-page booklet.
Circle 455.

Invertible chucker holders for ⅜ in. square tools cutting on rear of workpiece are described in a 4-page brochure.
Circle 456.

(continued)

PERISHABLE TOOLS

Useful Literature

(continued)

Toggle clamps, automation clamps, and die gages are shown and described in a 70-page workholding encyclopedia available from De-Sta-Co Div.
Circle 420.

Dover toggle clamps and plier grip clamps are described in a 16-page brochure.
Circle 421.

C-bar and T-slot clamps are described in a 4-page brochure.
Circle 422.

A wide variety of toggle clamps are listed in a selector guide folder.
Circle 423.

Multi-purpose locators for reusable applications in short run tooling jobs are described in a 4-page brochure.
Circle 424.

Thread cutting die heads are described in a 60-page catalog offered by Cleveland Twist Drill Co. It covers machinability tables, lead angles, cutting speeds, and basic screw thread data.
Circle 425.

Cobalt high speed steel drills in a wide range of sizes and styles are described in a 6-page brochure.
Circle 426.

Solid carbide commutator slotting cutters are described in a single page bulletin.
Circle 427.

High speed steel ground tool bits and cut-off blades are described in a 6-page brochure.
Circle 428.

Ball slides for precision friction-free linear movement are described in a 6-page brochure.
Circle 429.

Cutting oils, including the economics of their purchase and use, are covered in a pocket-size 10-page booklet offered by Shell Oil Co.
Circle 436.

Hydraulic fluids, including their selection and application for maximum economy, are described in a pocket-size 10-page booklet.
Circle 437.

Gold grinding wheels for use on high-speed milling cutters, form, and other tools are described in a 4-page brochure from Bendix Abrasives Div.
Circle 463.

Microbore tooling systems, and the fifteen different tooling product lines it offers, are described in an 8-page brochure available from De-Vlieg Machine Co.
Circle 444.

Its complete line of carbide products, including inserts, blanks, brazed tools, centers, and rest blades, is described in a 68-page catalog available from Ex-Cell-O Corp.
Circle 430.

CV-50 shank series tooling and accessories for NC machining centers is described in a 32-page catalog.
Circle 431.

CV-45 shank series tooling and accessories for NC machining centers is described in a 26-page catalog.
Circle 432.

The Goldex line of coated carbide inserts is described in a 4-page brochure.
Circle 433.

Diamond/borazon plated finishing tools for controlling close tolerances are described in a single-page bulletin.
Circle 434.

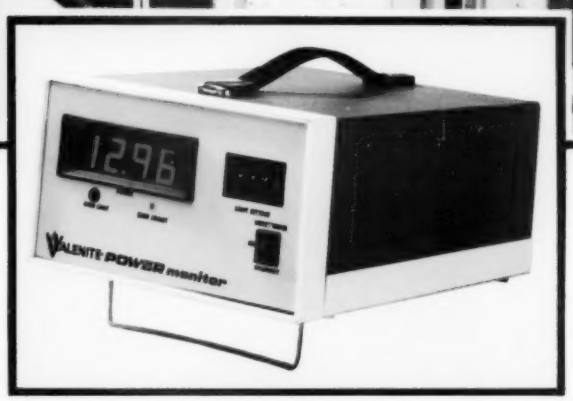
Metal marking (indenting) tools and machines are described in an 8-page guide available from Nobel & Westbrook.
Circle 457.

Numbering heads for use with marking presses or roll marking machines are described in a 4-page brochure.
Circle 458.

Interchangeable steel type for use in a wide range of metal marking holders are described in a 4-page brochure.
Circle 459.

General information about permanent marking, including tools, equipment, and contract marking services, is presented in an 8-page brochure.
Circle 460.

Horsepower Monitor Detects Hob Wear ...Helps Avoid Costly Wrecks



A major diesel truck engine manufacturer now uses machine tool horsepower to check excessive tool wear on spur gear hobbing operations.

The new Valenite HORSEPOWER MONITOR/CONTROLLER teamed with hobbing machine controls monitors wear on ten-pitch Class C hobs by constantly comparing true machine horsepower to a preset horsepower limit value.

The POWER MONITOR instantly signals excessive hob wear or impeding disaster due to machine malfunction, a poor hob, excessive tool wear or material hardenss variations. Output signals are used to signal the machine operator and can actually shut down the machine should true horsepower exceed a predetermined value.

INDICATE NO. 170 ON BUSINESS REPLY CARD

And, by using the POWER MONITOR to establish optimum tool wear/horsepower rates every manufacturer can maximize machine tool productivity.

The new Valenite POWER MONITOR is compatible with all A.C. and D.C. motors for all types of metal cutting equipment. Easy to use . . . fast to install . . . and best of all affordable to every shop, the new Valenite POWER MONITOR can help you keep production operations in the profit picture.

Contact your local Valenite Representative for an evaluation test on your machine. Or write for an informative brochure.

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Division of The Valeron Corporation

Manual programming demanding too much time?

New COMPACT II®-SERIES I system can create your NC tapes in minutes:*

MDSI's new COMPACT II—SERIES I computer assisted programming system is designed specifically to aid companies still programming manually. SERIES I creates accurate, machine-ready tapes in minutes instead of the hours currently needed for manual tape preparation. Firms that have switched to computer assist benefit from a significant reduction in the time it takes to produce NC tapes—*typically 5 to 10 times faster than manual programming. The mini-computer-based COMPACT II—SERIES I system puts in-plant, computer assisted NC programming to work for all your NC machines at a price which makes slower manual programming unaffordable.

With COMPACT II—SERIES I, the programmer remains in control, while the system does the calculations—thus freeing the programmer to use his skills and knowledge of NC machining to quickly produce efficient tapes. To assist the programmer, the COMPACT II—SERIES I includes such time-saving capabilities as:

- Elimination of manual arithmetic calculations.
- Automatic allowance for cutter diameter offsets and compensation.
- Automatic gage length compensation.
- Automatic calculation of feed strokes.
- Elimination of typing errors associated with manual tape preparation.
- Automatic calculation of clearance and depth for drilling.
- Single statement input for bolt circle patterns, linear arrays, etc.
- Provision for automatic stock allowance.
- Utilization of metric or inch input.
- Automatic machine tool code selection (m-codes, g-codes, etc.)
- Monitoring of machine axes limits.
- Plotting option proves programs on paper, not on the machine.
- Symmetrical and mirror-image parts easily programmed.
- Easy conversion of tape for use on an alternate machine.
- Programmer can specify either ASCII or EIA format.
- Extensive error checking of part programs.
- Produces tapes for similar parts with only minor editing changes.
- Easy editing for quick reaction to engineering changes.
- Automatic tape formatting.

All MDSI products and services are backed by formal customer training programs, excellent documentation and unparalleled professional technical support by the industry's largest field service organization.

For more information on COMPACT II—SERIES I, write today for our new 12-page brochure.

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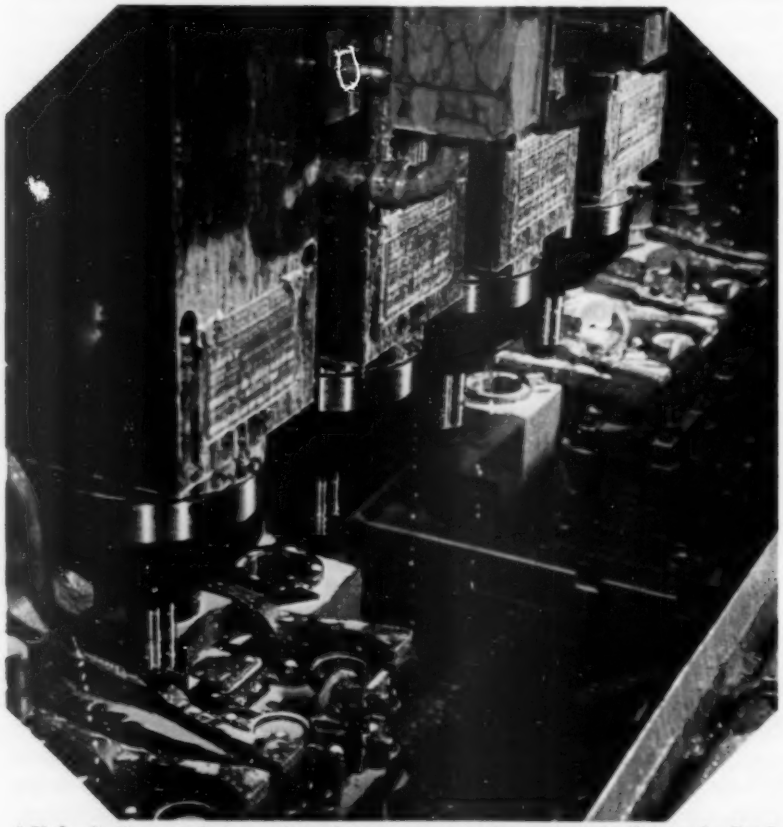
INDICATE NO. 171 ON BUSINESS REPLY CARD

Testing & Inspection Moves Into Production

PRODUCTION's 1978 Capital Spending Forecast (p.21) shows that the production metalworking industries will spend $379.8 million for testing and inspection equipment this year. That's up a whopping 10 percent over a good 1977



A Valenite Kamset Automatic tool size compensation units is built into the final finish boring station of the Snyder-built transfer line for machining cast iron compressor crankcases at a rate of 750 parts an hour. The system maintains size of the crank and cylinder bores. Tool size is automatically corrected in increments which can provide .0001 in., .0005 in., or .00002 in. adjustments. The user reports major reductions in line downtime can be credited to the gaging and adjustments

Many of those dollars will be spent to put the job of quality control on the production line. If this kind of in-process checking is part of your 1978 plans, here are some suggestions on how to cover the planning bases.

Although it may seem like a paradox, quality control is moving more and more into the realm of statistical record keeping and monitoring. The control of quality is increasingly a production function.

A major impetus behind this trend to assign the quality responsibility to the production man is that the gaging, inspecting, and testing equipment which assure quality are integral parts of the manufacturing equipment. And the planning of such checking equipment really ought to be part of the original equipment planning, say the authorities.

As a matter of fact, the practice of including inspection in some machining operations has become automatic. James C. Harris, vice president-sales, Landis Tool division of Litton Industries Inc., Waynesboro, PA, says: "Virtually 100 percent of our production grinders are shipped with in-process OD gaging. These gages

Do You Need In-Process Gaging?

Consider in-process gaging if:

- You're working with a critical dimension which will be hard to hold without such gaging
- In continuous production, a critical dimension may tend to drift out of tolerance because of thermal or mechanical changes (including tool wear)
- Production cycle time is now being lost due to the need for interruptions while manual checking is done
- You have an operation in which one or two close tolerances are causing excessive scrap
- Closer tolerances on mating parts might simplify assembly, reduce inventory, or produce a superior product
- The addition of such gaging would permit relatively unskilled operators to operate the equipment, or multiples of the equipment, performing mainly load and unload tasks

Note: If the machine will do it without the in-process gaging, then you don't need it.

can be used to reject the part, or the gages may be used to end the wheel in-feed so that a predetermined size is automatically held."

And William Bournias, executive vice president, F. Jos. Lamb Co., Warren, MI, reports that "every transfer line we now sell which included precision boring of cast iron also features in-process gaging of bore size to check for variations, including tool wear."

Why Use It? No matter how good production conditions are when it all begins, they will change—for the worse. That may be the Peter Principle at work. But with or without a principle to explain it, it is manufacturing fact. Authorities at the Automation & Measurement Div., Bendix Corp., Dayton, OH, point out: "Mechanical drift ultimately will take place on all semi- or fully-automatic machine tools. This drift is caused by: a) thermal deformation from electrical heat sources such as motors or relays, or mechanical heat sources by friction or slides, bearings, or spindles; b) coolant temperature change through machining and internal circulation; c) elastic deformation; d) vibration; and e) tool wear."

That means, left to its own devices, any machine will begin to turn out scrap. So the benefits of holding size or shape—detecting and correcting for "mechanical drift" either as it occurs or immediately thereafter—means improved productivity, reduced scrap rates, and consistent part quality. Engineers at Marposs Gauges Corp., Madison Heights, MI, say that controlling critical dimensions while they are being generated "ensures better quality production and reduces individual cycle times to the minimum required for each separate part. Only by gaging the part while it is being processed can the full precision and productive potential of modern finish machining techniques be realized."

Thus, in-process checking prevents a possible string of bad parts which can occur before the inspector calls a halt. Equally important, in more limited production rates of costly parts, the checking can prevent the scrapping of what may be an extremely costly part with thousands of processing dollars already invested in it.

Where Should It Be Considered? First, since it costs money to purchase and to operate, you'll want to use it only on critical dimensions—normally those which will affect a fit in assembly or a match which is important to the function of the part.

Second, you'll be using it mostly for finishing operations. It won't pay to even consider it on an operation which precedes heat treat or some other operation which might deform the part. And, for the most part, you'll want it for dimensions where tolerances will be .005 in. or less. (Some say .001 or less, but other considerations, such as the desirability of automation, may override those factors.)

Briefly, a distinction between in-process and post-process (in-line) inspection. Both may be automatic and may be an integral part of a machine or line cycle. The industry refers to in-process checking as that which is done on the surface at the time that surface is being generated. Thus, a caliper gage which rides the OD of a part being generated is an in-process gage. Post-process refers to the gaging done after the dimension or geometry have been generated, usually at a subsequent station.

Either can be used to spot a drift in the size, to signal either the operator or the machine for a correction, or to reject a bad part before it goes further in the process. If the job can be done in-process, as it can on OD grinding, then you have a more direct control of size or geometry. But where cutting tools interfere with the checking sensors (as in a relatively small bore), or when chips jeopardize the sensor, then post-process gaging is required.

By far, OD grinding is the most common operation used with in-process gaging. Grinding makes in-process gaging desirable because the surfaces are often accessible and because it usually involves close tolerances.

ID grinding also can be done readily, either by in-process or by post-process sensors. James Storm, marketing manager, Marposs, says it can be done on either horizontal or vertical machines in bore diameters as small as .120 in., with the sensor measuring the ID as it is being ground.

Storm also points out that Marposs gages are being used on surface grinders and on both centerless and double-disc grinders. "Because of access problems with the last two processes, gaging usually must be in-line, rather than in-process."

Additionally, in-line gaging is being done both in turning and in single-point boring operations on a production basis. The presence of chips makes both of these operations tough for in-process checking.

Machine Control. Ideally, checking during or immediately after the operation, can be tied into machine control. In some cases, that "control" is a readout or a warning light to signal the operator to make a necessary change. But more often, the signal is used to initiate an automatic correction on the machine.

Why Control? Tony L.Wendeln, staff application engineer at the Bendix Automation & Measurement Div., Dayton, OH, cites two prime benefits: reduced machining time and reduced scrap.

"The reduction of machining time is a result of the elimination of the need to stop machining while gaging a part. Cases where the part must be removed from the machine for inspection create an even greater delay and machine control gaging provides increased savings.

"Although other changes, such as temperature or distortion, affect part size and precision, tool and wheel wear is the No. 1 cause of size change from piece to piece. Monitoring the actual piece throughout the stock removal process is the only direct way to eliminate these variations. The constant updating of machine commands assures a reduction of scrap and opens the door to the total elimination of scrap."

In addition to the elimination of scrap, such gaging and control can have downstream benefits. At the Fiat-Allis plant in Springfield, IL, for example, the measure and compensation for finish bore size in track links (using VR/Wesson compensation on Snyder machines), the closer-tolerances on hole size has actually shown up in reduced assembly costs.

Another benefit: Since the operator may be involved almost exclusively in load-unload, he can be relatively unskilled and he can run two or more machines. Engineers at Federal Products Corp., Providence, RI , also point out that by holding the ODs and the IDs of mating parts to closer tolerances, "scatter" is reduced. This not only simplifies assembly, but it also can substantially reduce the size and cost of inventories.

Bendix's Wendeln ponts to two kinds of gage-machine control. The first, which he calls direct control, is that in which the gage measures the part during machining. For example, a caliper continuously monitors the diameter being ground. It can signal the reaching of two, three, or four preset control points. "The control points are determined by size and, as the gage head monitors the changes, relays within the amplifier control the machining process. They change the feed rate from coarse to fine and from fine to sparkout or dwell, stopping infeed of the wheel while allowing the truing of part geometry. At the final size, the gage will retract automatically; and, on machines properly equipped, the grinding wheel also will automatically retract.

"In indirect control, the checking is done immediately after the machining operations, as in centerless and double-disc grinding. In this type of control, the limits could be set at about 60 percent of the part tolerance. As an example, for a part with a ±.001 in. tolerance, the warning limits would be set for ±.0006 in. In post-process applications, the ideal situation is to monitor the piece as quickly after its processing as possible. On through-feed centerless and double-disc grinding, it is often possible for this to be only one part away from actual machining."

Variations on the control themes seem limitless. Dampening systems on the sensor can permit the gaging of interrupted surfaces. Where mating parts are being ground, the diameter of the female part is read, and the machine can be set to automatically grind the male part to a specified undersize —leaving, for example, a .0006 in. clearance.

Retrofit? Yes, say almost all authorities. But they all warn against trying to get old machines to do what they're incapable of. First, make certain the machine is capable of holding runout, parallelism,

(continued)

Questions To Ask

If you think you'll need in-process gaging, and you plan to contact some vendors for help, here are some of the things you should know:

- Which dimensions are involved and what are their tolerances?
- What is the sequence of operations, and at what point can gaging best be done?
- Will you be checking for anything in addition to size, such as taper, roundness?
- What datums will be used to locate the part?
- In what condition will the part be when gaged (cleanliness, etc.)
- If the part is held or clamped, will it be the same size and shape when it is released?
- What are the production rates required (pieces per hour, needs for processing more than one part number, and so forth)?

Bring Down Production Costs as You Increase Inspection Efficiency...

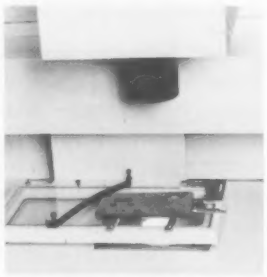
with EMR's non-contact optical inspection systems

Using the latest state of the art computer controls, EMR's non-contact optical inspection systems help to bring down production costs in two ways.

First, because they work extremely fast, they provide a rate of inspection that nears the rate of production. That means faster output.

Second, because they're extremely accurate (to within ± 50 microinches), they will not only detect more errors, but they are also less likely to reject good parts... more good part production with fewer rejects on the assembly line.

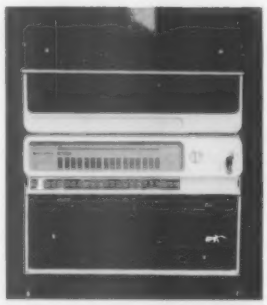
Locating and measuring hole diameters, measuring length and width dimensions, determining widths and depths of grooves and channels, examining heights and flatness of part sections, are



but a sampling of the types of inspections possible with EMR inspection systems.

New systems employ ultra-precision, positioning stage for any and all of the X, Y, Z, or rotational axes, a single or multiple digitizing scanner for direct computer input of visual data and a high speed mini-computer to control, compare, and evaluate results, EMR's optical inspection systems can inspect virtually an unlimited range of part sizes from very small to very large. The latest developments in surface illumination with probing laser light even further expands the capability of these systems through measurement of height, depth, blind holes, and slots.

If your cost to produce depends on your ability to inspect...Contact Tom Jackson at EMR for non-contact optical inspection systems.



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squareness, and size. If the machine ways or leadscrews are inadequate, forget spending money on costly gaging.

If the control and the machine feed mechanisms aren't capable of incremental precision feed, then the gage-control won't add precision. In some cases, it may pay to rework the machine, the control, or both; but the total cost, including that of the new gaging and control, has to be compared with their worth and with the cost of getting new equipment to do the same job.

Yet all of the companies in the in-process gage and control business have done extensive retrofit with their equipment. Federal Products, for example, put new gaging equipment on a 10-year-old crankpin grinder and reduced the scatter of parts from .0009 to just .0003 with no rework of either the machine or the control.

And Now, Video. If you have more than size to measure, don't overlook the possibility of inspecting parts, in-line, post-process using video systems. These are electro-optical automatic image analyzers. Two of the systems now on the market, each with field successes under their belts, are the Metric Eye of the Jones & Lamson operation of the Waterbury Farrel Div., Textron Inc., Springfield, VT, and the Comp-Gage made by EMR Photoelectric, a division of Sangamo Weston Inc., Princeton, NJ.

These instruments can optically scan parts, noting dimensions, shapes and positions of diameters, shoulders, holes, and so on, and then compare what they "see" with preprogrammed references. The signals can be used for printouts, for readouts, and there has been talk of their being used, through a computer, to feedback instructions in some cases to adjust a machine's NC program. The advent of automatic optical scanners and "decision makers" is altering the manufacturing inspection scene.

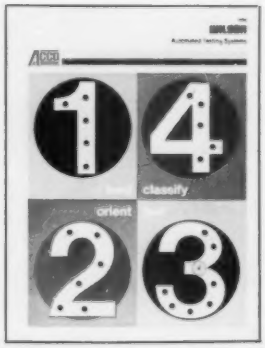
A J&L Magic Eye system has been designed to scan 24 in. by 24 in. circuit boards. At present, outputs can be merely an accept-reject mode in audio or visual signals, or a teletypewriter can print a hard copy result. A sorting mode also can be provided in which parts are sorted into tolerance classifications, or there can be a feed-back mode to tie into production equipment.

A Comp-Gage is now working, checking the diameter, arc length, and proper crimping of pipe couplings. Total inspection time per part is less than a second. The machine output is a series of lights which indicate acceptable or unacceptable: A third light will indicate the machine cannot make a decision. The machine cycle is completely automatic. The user can reprogram the machine for a whole family of couplings ranging from approximately 3 in. to 10 in. Reprogramming time is about 2 minutes.

Video is the newest technique for helping to close gaps in manufacturing quality. The goals of all the methods are to avoid bad parts, get mistakes out of the manufacturing stream as soon as possible, and get on with efficient production of quality parts. *RFH* □

Useful Literature

Optical comparators and coordinate measuring machines as well as accessories and auxiliary equipment for broadening their applications in measurement and analysis applications are described in a 40-page brochure by Jones & Lamson.
Circle 527.



Automated testing and inspection systems that automatically feed, orient, test, and classify parts and materials are described in an 8-page brochure offered by Wilson Instrument Div. of Acco.
Circle 528.

A Rockwell hardness tester capable of performing up to 1500 tests an hour is described in a 4-page brochure.
Circle 529.

Riehle hydraulic and screw powered testing machines, as well as a closed-loop servo-controlled testing system is described in a 12-page brochure.
Circle 530.

An automatic Brinell hardness tester capable of up to 450 part tests per hour is described in an 8-page brochure.
Circle 531.

A programmable electronic measuring system designed for in-process gaging in manufacturing as well as general inspection and quality control operations is described in

ALINA Programmable Measuring Systems

a 16-page brochure by Alina.
Circle 532.

Precision in-process gaging systems designed to be incorporated into transfer lines or mated with machine tools to increase productivity through monitoring, feedback compensating, classifying,

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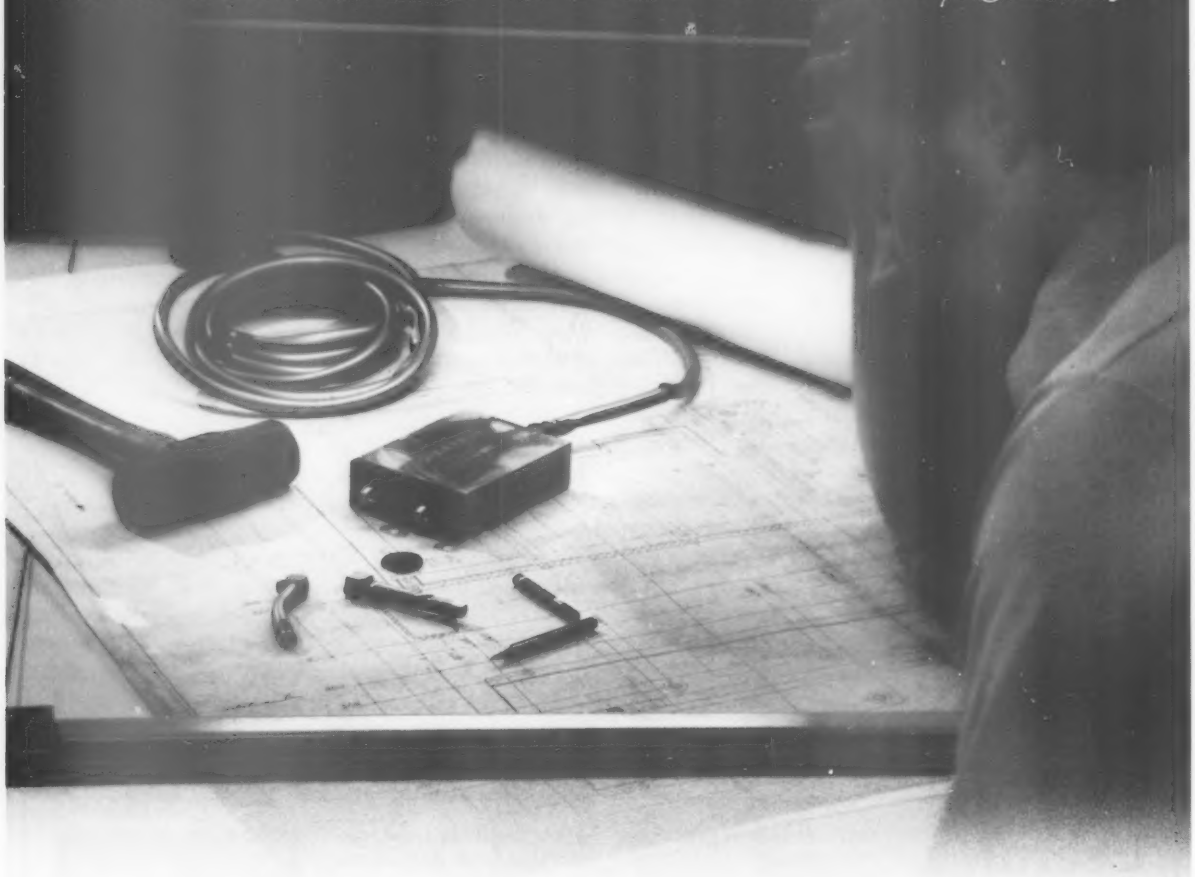
In Quest of the Indestructable In-Process Gauge... OR...

Never Underestimate the Power of Human Ingenuity



Marposs engineers have been working on an indestructable in-process gauge for several years. The new design has about 10 percent of the moving parts found in our original gauge heads; is substantially more durable; and even has a unique fluid damping system to eliminate most vibration and impact problems.

We put it on test in a customer's plant.

They ran it into grinding wheels. They dropped workpieces on it. They bathed it in coolant and covered it with abrasive swarf and dust. Net damage: a couple of bent contact arms, and not much else.

We were feeling rather smug.

Then the operator destroyed the gauge by the simple expedient of beating on it with a large hammer. "Coarse adjustment" he called it.

So, it's back to the drawing boards for us. But, if you would like to take a look at an **almost** indestructable in-process gauge, write or call for our new brochure.

Maybe your operators won't think of using a hammer.

MARPOSS

Marposs Gauges Corporation

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CIRCLE NO. 29 ON READER INQUIRY CARD

Useful Literature

(continued)

and marking functions are described in a 6-page brochure by Ex-Cell-O Corp.
Circle 533.

A modular linear surface analysis system is described in a 4-page bulletin offered by Gould Inc.
Circle 543.

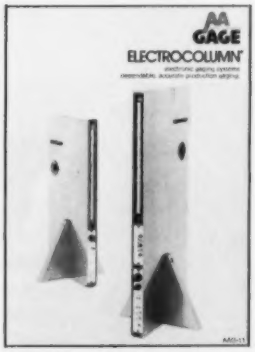
A microcomputer-based nuclear gaging system for precise control of web, sheet, cloth, strip, or coating thicknesses is described in a 12-page brochure offered by Fife Corp.
Circle 534.

In process grinding gages for use on cylindrical grinders are described in a 12-page brochure offered by Arnold Gauge Co.
Circle 544.

Coordinate measuring machines are presented in a 20-page brochure by Bendix Automation & Measurement Div. It discusses manual applications, use of computers, and direct computer control in high volume inspection.
Circle 545.
Bendix-Portage inspection machines, and their features and applications, are described in a 12-page brochure.
Circle 546.

Sheffield gages and machines for inspection and testing of ball and roller bearings and components are described in a 16-page brochure.
Circle 547.
Surface roughness, profile, and roundness measuring and recording instruments are described in a 12-page brochure.
Circle 548.

Semiconductor strain gages, temperature sensors, and integrated force/deflection sensors are described in a 20-page brochure by Kulite Semiconductor Products, Inc.
Circle 535.



Electronic column-type gaging systems are described in a 12-page brochure available from AA Gage.
Circle 536.
Digital electronic gaging systems are described in a 4-page brochure.
Circle 537.
Rotary tables for NC production and inspection are described in a 2-page folder.
Circle 538.

Examples production applications of electronic gaging and automatic size control are presented in a 12-page brochure available from Valeron Corp.
Circle 542.

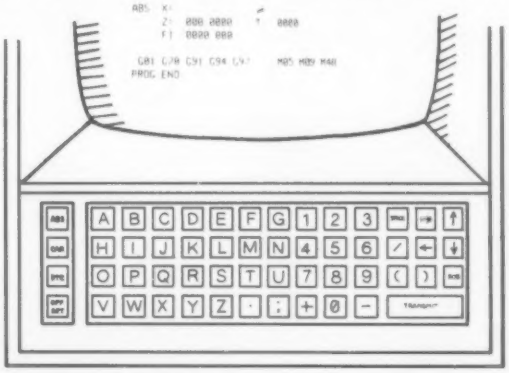
An automatic halogen leak detecting system is described in a 2-page bulletin offered by Scans Associates, Inc.
Circle 539.
A dynamic balance leak test system for water pumps is described in a 2-page bulletin.
Circle 540.
Top dead center locating equipment is described in a 2-page bulletin.
Circle 541.

All CNC features are not created equal.

Most computerized numerical control (CNC) units on the market offer the same basic checklist of features. But years of working with our customers to meet their requirements have resulted in a clear difference in our Series 7300 CNC. It offers the most comprehensive, practical, and easy-to-use CNC features available. When can we arrange a demonstration? Ask for Publication 7300-900.

Built-in diagnostics

provide on-line monitoring of machine and control status; extensive off-line diagnostics allow specific area testing.



Programmable Interface

allows rapid troubleshooting of machine interface logic in familiar ladder-diagram form.

Full edit and input

capability on all programs: manual data input, punched tape, stored program and stored pattern.

Full keyboard/CRT display

Complete alpha-numerics for manual entry or communications within a CAM system.

Quality in the best tradition.

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Cleveland, Ohio 44143

CIRCLE NO. 30 ON READER INQUIRY CARD

Does Your Plant Need Programmable Controllers?

By completing the following questionnaires, you can determine if programmable controllers can make your plant more efficient, what kind of programmable controller you need, and how to select a supplier

Are any machine tools or processes in your plant controlled by electromechanical relays? A "YES" response to this question most assuredly indicates you have a candidate application for programmable controllers. It does not, though, tell you what you can do with a PC, what type of PC capability you require, or suggest where to acquire necessary equipment.

But by completing three questionnaires included in this section of PRODUCTION's Manufacturing PLANBOOK: 1978, it's possible to make these determinations in-house. Accompanying text will explain what a programmable controller is, will discuss the economic implications of using such devices, and will review some proven PC applications.

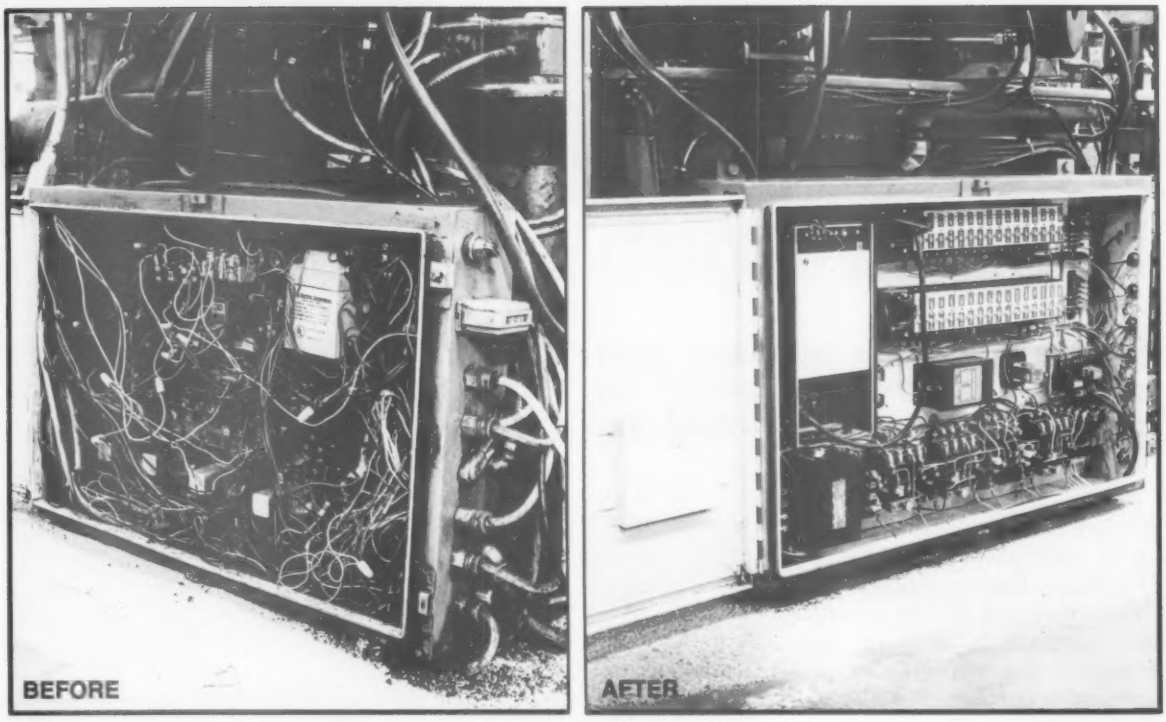
To some extent, PCs are still a well-kept secret in the industrial world. Fewer than 30,000 have been installed over the past nine years, and many engineers still fail to clearly comprehend how they differ from other types of industrial controls and computers.

Using a hand-held programmer, this engineer is making changes in a program that directs a plastic injection molding machine on the shop floor. The ease of reprogramming is a major selling feature of PCs for manufacturing operations

Definition of Terms. A programmable controller is a solid state device that uses softwired logic contained in the controller's memory to duplicate the functions of relays and hardwired solid state control devices. In operation, the memory unit sequentially scans inputs (sensors, limit switches, pushbuttons, photocells) in cyclical fashion to determine which outputs (contacts, motor starters, solenoids, pilot lights, converters, etc.) should be turned on or off.

This method of processing information is one of three key characteristics which set PCs apart from computers . The PC processes instructions in a fixed cycle. Instructions can be skipped or not performed, but they are all at least examined on every scan. Computers, on the other hand, operate on an interrupt system whereby changing events can alter the order in which instructions are performed. This speeds response time in relation to PCs, but adds complexity to programming.

A second difference between PCs and computers is in the way the controller is programmed. Ladder diagram logic, the same used to "program" electromechanical relays, is also used in PCs.



This before and after shot of a machine control updated from hardwired relays to a PC shows why PCs are easier to maintain and troubleshoot than are relays

Control engineers working with relays should be familiar with this language; if they are, they can be taught to program a PC in as little as 15 minutes. This is significant because it makes the PC a shop tool, not a data processing system.

The other distinguishing characteristic of PCs is their rugged construction. Equipment is designed to withstand jarring, freezing and elevated temperatures, high humidity, corrosive atmospheres, and electrical interference.

PCs for Relay Replacement. As a straight replacement for relays, PCs have a lot going for them. They are two or three times more reliable than electromechanical relays. They usually can reduce equipment downtime due to electrical malfunctions by 30 percent. They can be installed in one-fifth the time it takes to wire a relay panel. They provide instant fault identification. And they can be programmed and reprogrammed faster and less expensively than hardwired systems.

The climbing cost of wiring relay panels is also beginning to make PCs increasingly attractive. Today, wiring and installation typically runs from $30 to $50 per relay, but can go as high as $80 to $100 per relay in plants operating under a high labor burden. This, coupled with the fact that PC prices continue to fall in relation to capability, now makes the PC cost competitive for applications where as few as 10 to 25 relays are replaced.

Cost Justification. There are several pitfalls first-time users of PCs should avoid. Foremost is believing that an investment in PCs can be justified by the purchase of a single system replacing, say, 15 relays. Few builders recommend their product for such a limited application unless the customer plans to add another 10 to 15 controllers over the next couple of years.

The issue is not the initial purchase price of a PC, but the cost of supporting equipment. Consider a low-end-of-the-line system purchased to replace 15 relays. The programmable sequencer in such an application will cost approximately $800. However, a first-time user will also have to purchase a programmer. These run about $1400, raising the initial investment for a bare-bones system to $2200.

Because it's advisable to have backup for each element of a system, this figure must be doubled. And at this point, no provisions have been made for programming costs, maintenance costs, or for the addition of options like a simulator to pre-check inputs and outputs before programming the programmable sequencer, a computer interface, CRT display panels, diagnostic capabilities, or the four arithmetic functions.

Users planning to put 10 or 15 PCs on-line for a five-year period need only one set of spare parts for this size installation. Consequently, the cost of spare parts, programming, maintenance, and

(continued on page 101)

DO I NEED A PROGRAMMABLE CONTROLLER?

Before answering the following questions, take a few minutes to visualize all operations in your plant, including manufacturing, testing and inspection, materials handling, shipping and receiving, finishing, welding, and energy management.

Yes	**No**	**Do you have any equipment or processes controlled by 10 or more relays?**
Yes	**No**	**Are you satisfied with the reliability and uptime of relay-controlled machine tools and processes?**
Yes	**No**	**Are you experiencing excessive downtime due to electrical problems?**
Yes	**No**	**Do you spend an excessive amount of time isolating the cause and location of electrical problems?**
Yes	**No**	**Do relay control panels occupy floor space needed for other purposes?**
Yes	**No**	**Do existing relay panels put a drain on energy consumption?**
Yes	**No**	**Do control requirements change frequently, say, once a month, and require rewiring or logic changes?**
Yes	**No**	**Must you monitor operations presently controlled to detect and report malfunctions, part counts, machine uptime, etc.?**
Yes	**No**	**Does existing equipment have provisions for adding monitoring capability without major rework?**
Yes	**No**	**Do you operate equipment on a multi-shift basis, shortening relay life?**
Yes	**No**	**Do you anticipate extending, or having to extend, the capability of existing controls by modifying them or by adding hardware?**
Yes	**No**	**Do you have any highly repetitive operations being performed by employees?**
Yes	**No**	**Do you have any operations of a repetitive nature being handled by workers in an uncomfortable or hazardous environment?**
Yes	**No**	**Do you inspect large quantities of raw materials or finished goods visually?**
Yes	**No**	**By weight?**
Yes	**No**	**By volume?**
Yes	**No**	**By dimensions?**
Yes	**No**	**Would automatic tabulation of inspection results be valuable under such circumstances?**
Yes	**No**	**Do you have process-type operations requiring continuous or periodic monitoring of pressures, flow rates, vacuum, leakage, spills, temperature, or humidity?**
Yes	**No**	**Is control of such variables required?**
Yes	**No**	**Is your maintenance staff knowledgeable in troubleshooting relay equipment?**
Yes	**No**	**Can you readily train new employees to use and maintain relay controls?**
Yes	**No**	**Do you use conveyor systems or stacker cranes for materials handling?**
Yes	**No**	**Is speed of start-up of new equipment critical?**
Yes	**No**	**Do you have a need to fine-tune or optimize the performance of existing equipment to increase productivity?**
Yes	**No**	**Do present control systems permit equipment to be economically optimized?**
Yes	**No**	**Do you require data storage capabilities?**
Yes	**No**	**Do you plan to convert more than one or two machines to PCs at the time of remechanization?**
Yes	**No**	**Do you expect to add more PCs within the next three to five years?**

If you have not circled one or more YES answers you probably do not have an application for programmable controllers—at the present time. If you have responded positively to even one question, however, complete the following two questionnaires in order to get an idea of the type of system you require, and questions to ask in selecting a supplier.

The **GN5M** microprocessor CNC for milling machines and machining centers offers 0.0001-in. input resolution and 2-axis linear and circular interpolation and third-axis linear interpolation, with absolute/incremental programming in the same tape block. In addition to the many standard features listed below, options include programmable interface, cutter radius compensation, program storage and editing.

General Numeric's **GN5T** microprocessor CNC is designed to provide low-cost computerized control for lathes. The X and Z axes are simultaneously controllable with circular interpolation. Standard equipment includes: canned cycles for turning, threading and facing; thread cutting; and 16 pairs of tool offsets in memory.

GNC Model microprocessor CNC's provide simultaneous 3-axis linear and circular interpolation switchable to any 2 axes for milling machines and machining centers. Optional field-installable modules can provide a 4th axis, programmable interface, position display, cutter radius and stored pitch error compensation, helical cutting, program storage and editing and DNC link.

Our **Model GN7M** control for milling machines and machining centers has 3-axis capability with linear interpolation in all axes and simultaneous, circular interpolation in the X and Y axes. Also standard is switchable plane circular interpolation, permitting you to switch ZY or ZX, as well as XY. The optional 4th axis can also be switched to circular interpolation, so that if 4th axis is W, you can have XY, XZ, YZ and YW. Standard features include up to 99 callable subroutines for family-of-parts programming, software limit switches and tape edit without entering tape in memory.

Our most sophisticated lathe control is the **GN7T**. Its *standard* output resolution is 0.00005 in. Maximum standard feed rates are 1500 in./min or 5.000 in./rev. Rapid traverse rate is 1500 ipm. Standard features include: software limit switches, buffer block retention after interruption, circular interpolation in all axes and direct programming in inches/rev. Options include full tool tip radius compensation, constant surface speed control and leadscrew error compensation.

General Numeric microprocessor CNC's ...the new standard of numerical control for the machine tool industry.

Standard features on every General Numeric microprocessor CNC include:

■ Built-in diagnostics, usable while executing a part program ■ EIA/ISO switchable ■ Positioning and linear interpolation ■ Buffer storage ■ Program any arc up to 360° in one block ■ Optional block skip ■ Optional stop ■ Block delete ■ Canned cycles ■ Zero offset ■ Backlash compensation ■ Dwell ■ Universal display ■ Zero return ■ Feed hold ■ Interlock ■ Machine lock ■ Display lock ■ Keyboard type manual data input ■ Jog ■ Single block operation ■ Dry run mode ■ Automatic acceleration/deceleration ■ Tape reader

In addition, depending on the model, you will find that standard equipment can include such features as mirror image, circle cutting, helical cutting, sequence number search, inch/metric switchable from either inch *or* metric leadscrews, midtape start-up, program restart without losing buffer block, program copy, up to 99 tool offsets, programmable limit switches, programmable machine interface, rapid traverse override, constant tangential feed rate control, built-in slide position display, thread cutting and retrace function.

The complete line of General Numeric microprocessor CNC's includes, in addition to the 5 models shown above, the new Mate M, which is an inexpensive, highly reliable, 3-axis MDI programmer for milling, turning, drilling, punching, laser cutting, EDM, welding and contour sawing machines. We also offer a full line of servodrives, servocontrollers, spindle drives and robots. For specs, prices and delivery dates, phone, Telex or write Mr. T. C. Smith, vice president.

We also offer over 5 million hardware and software option combinations.

GENERAL NUMERIC

390 Kent Avenue,
Elk Grove Village,
Illinois 60007
312/640-1595
Telex: 280599

CIRCLE NO. 31 ON READER INQUIRY CARD

Texas Instrument's 5TI programmable control system (shown) replaces from 15 to 200 relays. A larger system, the 7TI, will be introduced early this year

(continued)

selected options can be distributed over 15 units.

In-house Talent. Another up-front evaluation candidates for PCs must make regards the capabilities of in-house controls and maintenance personnel. PC builders can school personnel in programming if they understand ladder diagram logic. If that is not the case, avoid PCs because ladder diagrams are basic to their application. Furthermore, few PC builders are equipped to teach this aspect of controls technology. As for maintenance, if you lack in-house electrical capability to service relays, it is unlikely you will be able to maintain PCs properly.

The third hurdle to overcome in deciding whether to install PCs is to avoid being short-sighted in planning; that is, avoid viewing programmable controllers only as replacements for electromechanical relays. Systems on the market today, particularly the microprocessor-based systems which are taking over the industry, have capabilities far beyond what relays can offer. Failure to recognize these capabilities—and to use them—is one reason some first-time users underutilize equipment by as much as 70 percent.

System Capability. Besides effectively handling the basic functions of timing and counting, state-of-the-art equipment can: add, subtract, multiply, and divide; monitor equipment for good parts run, rejects produced, uptime, and efficiency; provide adaptive controls; diagnose system failures; in-

(continued)

WHAT TYPE OF PROGRAMMABLE CONTROLLER DO I NEED?

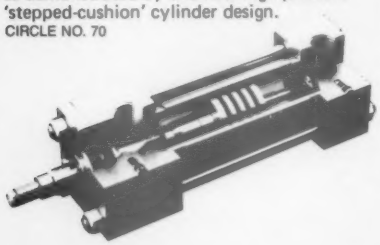
Yes	No	Will your smallest control application require fewer than 20 inputs/outputs (I/Os)?
Yes	No	20 to 40 I/Os?
Yes	No	Will your largest control application require 40 to 120 I/Os?
Yes	No	120 to 1000 I/Os?
Yes	No	More than 1000 I/Os?
Yes	No	Do you require only digital I/O capability?
Yes	No	Will your control application require analog I/O capability?
Yes	No	Will your application involve pulse-type signals like stepper motors and encoding devices?
Yes	No	Will all I/O devices be located within a confined area, say, within a radius of 100 ft?
Yes	No	Do you plan to include, or add at some future date, reporting or data displaying equipment such as CRT terminals or line printers?
Yes	No	Is there the possibility the PC will be connected to a control computer in a hierarchial system?
Yes	No	Will the application require programming equipment to diagnose faults, display status, generate documentation, or handle off-line programming?
Yes	No	Will the controller need to have full range ac/dc capability?
Yes	No	Will you require protection or limited access to information stored in the memory?
Yes	No	Must the control retrofit to an existing machine or operation?
Yes	No	Will you do the engineering installation, programming, and checkout using in-house personnel?
Yes	No	Will you contract some of the work?
Yes	No	Most of the work?
Yes	No	All of the work?
Yes	No	Do you presently have personnel knowledgeable in PCs, or who can be readily trained?
Yes	No	Do you have service/maintenance personnel familiar with ladder diagram logic?
Yes	No	Do you have any severe environmental conditions which may affect equipment?
Yes	No	Must you produce a cost justification to get approval of a purchase?
Yes	No	Do you have any inherent resistance within your plant toward the use of PCs such as fear of programming, maintenance, or losing memory in the event of a power outage?

THE FLUIDPOWER COMPONENT SOURCE DECISION:

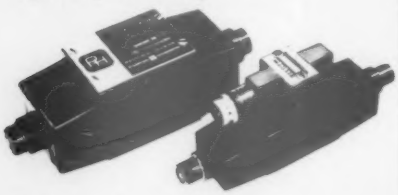
Make it Parker.

Parker Fluid Power Components represent the industry's highest level of engineering and manufacturing skill and are backed by an international network of distribution and service locations.

HYDRAULIC & AIR CYLINDERS—Parker not only offers the industry's number one line of hydraulic and pneumatic cylinders—but continually leads the field in engineering innovation and product development—as demonstrated by this new high pressure 'stepped-cushion' cylinder design.
CIRCLE NO. 70

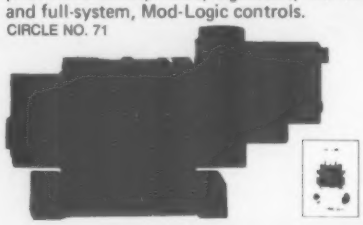


DIRECTIONAL CONTROL & PRESSURE CONTROL VALVES—Parker's wet armature directional control valve series is a major engineering breakthrough!

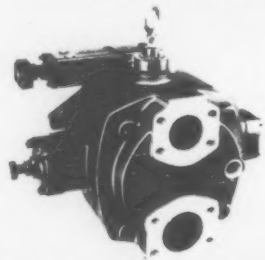


These new valves are virtually leakproof and operate cooler for longer valve life. They're part of a directional and pressure control line that is setting higher industry standards in performance and in reliability.
CIRCLE NO. 73

PNEUMATIC PRODUCTS—The new 4501 Series Air Valve—plus the low cost, mid-range regulator (shown in insert), are important additions to our great selection of pneumatic valves, filters, regulators, lubricators and full-system, Mod-Logic controls.
CIRCLE NO. 71

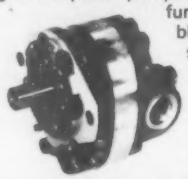


PARKER PUMPS & MOTORS—A welcome addition to Parker's growing pump and motor lineup is the PVV 142 variable volume vane pump that delivers piston pump efficiency.



The line also includes fixed vane and gear pumps, as well as, fixed and variable volume piston pumps—and Nutating hydraulic motors.
CIRCLE NO. 74

FOR MOBILE APPLICATIONS—Parker directional and flow control valves, gear and piston pumps . . . plus the multi-function Hydro-Flex block valves represent part of a full line of products available for mobile applications.
CIRCLE NO. 72



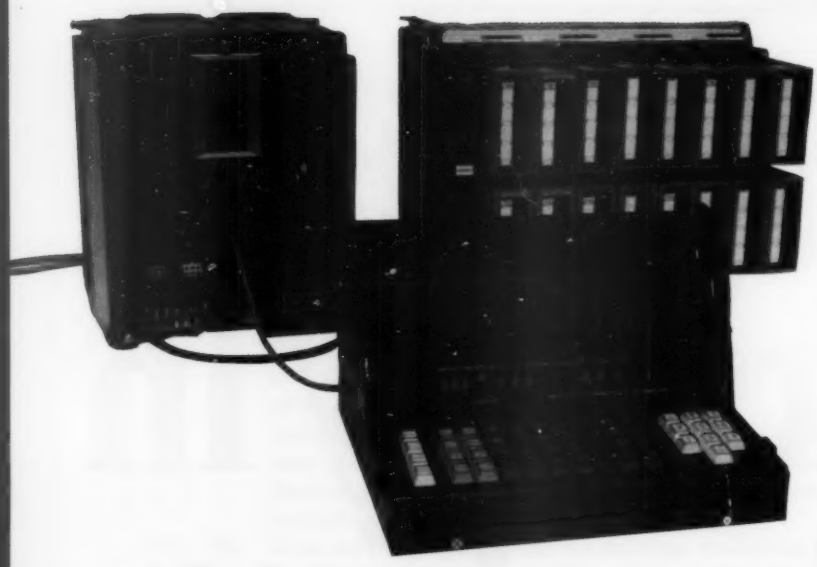
POWER UNITS AND TOTAL SYSTEMS—Parker makes everything in a fluid power system but the fluid . . . We also know how to put it together into reliable power units, or total fluid power systems.

FLUID POWER TRAINING—The connection with Parker also connects customers to the finest fluid power training available—The highly regarded, Parker Involvement Training Programs cover everything from Basic Hydraulics to Advanced Circuit Design . . . and are available for local presentation. Ask for full details.
CIRCLE NO. 75

PH-2

For detailed product information write:
Catalog Service Center, Parker Hannifin Corp.
17325 Euclid Ave., Cleveland, Ohio 44112

Parker Fluidpower



Allen-Bradley's PLC-2 microprocessor-based PC can handle up to 256 I/Os in applications requiring a compact, small-scale system which provides the key features and capabilities of advanced PC technology

(continued)

terface with a central computer and other peripheral equipment; and much more.

To visualize how such capabilities can fulfill in-plant requirements today and in the future, review all plant operations from the standpoint of how they should be controlled under optimum conditions. For an original equipment manufacturer, this is best decided by a group made up of control engineers, sales and marketing people (to determine what customer needs are), and a representative of the manufacturing staff. Such a group for a discrete parts manufacturer should include plant engineering, process engineering, and plant management. The accompanying charts will assist these groups in their planning.

Proven Applications. It is no exaggeration to say that today there is no segment of metalworking where PCs do not at least have a foot in the door. Applications range from large and small transfer lines, automatic assembly equipment, injection molding machines, and industrial robots to energy management, materials handling, and testing and inspection.

Typical of an automotive application would be the use of PCs to monitor 66 production machines. Total parts, rejected parts, parts produced, machine efficiency, and machine cycle time are reported to a central location via LED displays, and at the end of each shift the PC prints out a summary of operations.

In another machine tool application, a PC controls tool changing on a synchronous metalcutting machine with 85 tool groups. A system was needed to keep track of how near each tool was to required replacement based on the number of parts manufactured. Provisions had to be made for displaying by number all tools requiring a change as well as accumulated counts and replacement levels for all tool groups.

Builders of plastic injection molding machines also are beginning to turn to PCs in increasing numbers, particularly for fine-tuning or optimizing operations. Other successful applications include controlling conveyor systems, stacker cranes, automatic plating lines, paint spraying lines, pollution abatement equipment, compressor stations, automatic welding machines, plastic batching and mixing systems, and automatic gaging and inspection equipment.

Why Buy a PC? Programmable controllers have been proved effective under the most severe manufacturing conditions imaginable. They are reliable, cost effective (increasingly so on more complex machinery), and are con-

(continued on page 107)

Because this section on programmable controllers is designed as a planning aid, reference to specific manufacturers and users of programmable controllers have been avoided. Without the aid of the following individuals, however, it would have been difficult to compile the information presented.

Ernest F. John,
production application supervisor
Programmable Controls
and
L. O. Rexrode,
marketing services manager
Systems Div.
Allen-Bradley Co.
Highland Heights, OH

John A. Blaeser,
general manager/president
and
Bruce R. Rusch,
vice president-marketing
Gould, Modicon Div.
Andover, MA

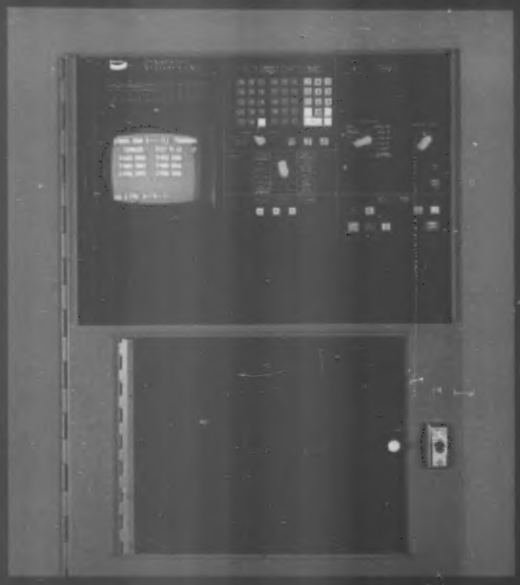
Michael Marshall,
marketing manager
Industrial Products Group
Digital Equipment Corp.
Maynard, MA

Richard Hull,
marketing manager
Industrial Controls
Materials & ELectrical Products Group
Texas Instruments, Inc.
Attleboro, MA

William A. Kaveny,
vice president and general manager
The Herman Corp.
Zelienople, PA

When you talk productivity in metalworking,

we speak your language.



We speak your language with Bendix CNC.

Our newest generation CNC has it all over conventional hard-wired N/C's. It can do anything they can. Plus it gives you added capabilities like part-program storage and edit. Built-in diagnostics for itself and for the machine it's controlling. Almost unlimited feeds and speeds. And easy, reliable maintenance.

It avoids obsolescence. The soft-wired control on our DynaPath System 5 CNC lets you add new features as they develop. Simply insert a new operating program from a punched tape.

A cathode ray tube (CRT) display system is standard. It presents all information including dimensions, control status, tool offset charts, operator messages and trouble identification from built-in diagnostics. And Bendix has service centers nationwide if service is necessary.

Order the entire Bendix DynaPath System 5 CNC on any machine tool from any major machine tool builder. He'll have delivery information. The Bendix Corporation, Industrial Controls Division, 12843 Greenfield, Detroit, Michigan 48227.

We speak your language with Bendix Cordax® Inspection Machines.

Replace complex, lengthy inspection methods with the high speed and accuracy of Bendix Cordax® Inspection Machines.

Our small-sized, economical Model 1000 gives high reliability with .0001 resolution.

The Model 3000 has larger measuring ranges as options for measuring medium to large parts. 30" (x axis) by 20" (y axis) is standard.

Large, heavy parts need the high resolution, medium measuring range and 39" work height capacity of our Model 5000.

For oversized parts, the Model 7000 has a range of 72" by 30" by 24" with special probes and software available.

Our Model 9000 uses a 28,000-pound granite base and 96" by 54" by 36" measuring range for large, heavy workparts.

We also build a completely automatic DCC 5000

Model with direct computer control. And it's designed specifically for high-volume inspection.

For more information, write or phone your Sheffield product representative (under "Gauges" in the Yellow Pages). Or contact: The Bendix Corporation, Automation & Measurement Division, Box 1127, Dayton, Ohio 45401. Phone: (513) 254-5377.

We speak your language with the Bendix Flexible Machining System.

The Bendix Machine Tool Corporation Flexible Machining System has the capability to cut the per-piece cost of mid-range parts.

Thanks to multiple spindles, it can bore, drill, ream, tap or countersink multiple holes in low and medium production parts. And it's most productive in the range of 4 to 15 pieces per hour.

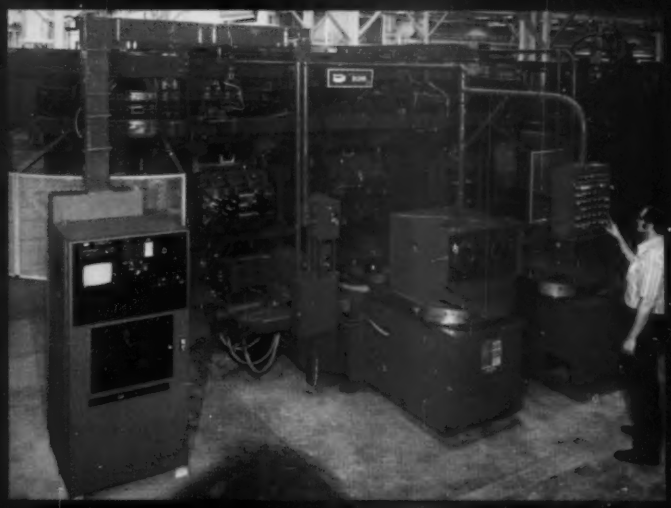
The multiple cutting tools operate in vertically suspended multiple tool heads. Tool heads are indexed individually into the work station under programmed, N/C or operator control.

After one head completes its operation, a slide unit fully retracts so the next head can go to work. The entire sequence takes about ten seconds from cut to cut.

A typical operation may have 20 or more tools on an infinite number of multiple tool heads. Later, the heads can be used without modification on special machines for increased production rates.

Reliable? This system keeps downtime to a minimum. It's completely mechanical. Any cutting tool changes, maintenance or other adjustments can be made while the machine is running.

It's an efficient system for machining multiple holes in covers for



motors, gears, pumps, transmissions and other parts attached by screws or bolts.

Interested? Just contact: Bendix Machine Tool Corporation, subsidiary of The Bendix Corporation, 11355 Stephens Drive, Warren, Michigan 48089. Phone: (313) 755-6000.

Bendix

CIRCLE NO. 34 ON READER INQUIRY CARD

(continued)

WHERE SHOULD I BUY A PROGRAMMABLE CONTROLLER?

Yes	No	**Is the supplier well-known and established in the marketplace?**
Yes	No	**Will the supplier be in the PC business 3, 5, or 10 years from now?**
		Does the supplier have a good track record with regard to:
Yes	No	**Equipment delivery?**
Yes	No	**Off-the-shelf spare parts availability?**
Yes	No	**Training assistance?**
Yes	No	**Service support?**
Yes	No	**Does the manufacturer supply all of the peripheral devices you will require, with necessary interface, in a proven system? (Note: Determine during purchase negotiations the cost of future system enhancement.)**
Yes	No	**Does the supplier provide assistance in the application, installation, and programming of new systems? (Note: Be sure to have spelled out in writing the degree of support provided, fees, add-on charges not covered in the routine contract, and the turnaround time to put equipment into operation.)**
Yes	No	**Does the manufacturer have a fulltime, dedicated field service organization convenient to your location?**
Yes	No	**Will the supplier conduct on-site schools for your personnel?**
Yes	No	**Does the supplier conduct schools on a scheduled basis using fulltime instructors?**
Yes	No	**Will the supplier be interested in your business if you require only a few controllers?**
Yes	No	**Can the manufacturer tailor his equipment to your application without overkill (and related costs) so that you do not have to pay for capabilities not needed now or in the future?**
Yes	No	**Is the manufacturer's equipment design so restrictive that it will prevent unexpected expansion in areas such as I/O capability, memory, and interfacing with peripherals, at some future date?**
Yes	No	**Is equipment competitively priced?**
Yes	No	**Does the manufacturer have a reputation for keeping abreast with technology?**
Yes	No	**Does the supplier handle a line of equipment broad enough to meet both your present and future control requirements?**
Yes	No	**Is the manufacturer's equipment proven in applications similar to yours?**
Yes	No	**Is the company financially sound and well managed?**
Yes	No	**Has the company previously shown interest in solving your control problems?**

PC Manufacturers With Proven Track Records Include:

Allen-Bradley Co. Systems Div.
747 Alpha Dr.
Highland Heights, OH 44143
(216) 449-6700

Cincinnati Milacron
Electronic Systems Div.
Lebanon, OH 45036
(513) 494-5361

Texas Instruments, Inc.
Control Products Div.
Mail Station 10-10
Attleboro, MA 02703
(617) 222-2800

Struthers-Dunn Inc.
Systems Div.
4140 Utica Ridge Rd.
Bettendorf, IA 52722
(319) 359-7501

Eagle Signal Div.
Gulf + Western Industries
736 Federal St.
Davenport, IA 52803
(319) 326-8111

Westinghouse Electric Corp.
Numa-Logic Dept.
32031 Howard
Madison Heights, MI 48071
(313) 588-1540

Reliance Electric Co.
24701 Euclid Ave.
Cleveland, OH 44117
(216) 266-7000

Digital Equipment Corp.
146 Main St.
Maynard, MA 01754
(617) 897-5111

Square D Co.
Systems, Dept. SA
Milwaukee, WI 53201
(414) 332-2000

Modicon Div., Gould Inc.
Box 83
Shawsheen Village Station
Andover, MA 01810
(617) 475-4700

General Electric Co.
General Purpose Control Dept.
Box 2913
Bloomington, IL 61701
(309) 662-4311

Industrial Solid State Controls, Inc.
435 W. Philadelphia St.
York, PA 17405
(717) 848-1151

(continued on page 111)

"We stacked the 5TI Programmable Controller up against relays. The 5TI came out on top."

H.C. Vacketta, Manager,
Eastern Sales and Applications
Engineering, Food Processing
Machinery Division,
FMC Corporation

"When we designed our CP-20 Case Palletizer, we wanted to reduce costs—for our customers and ourselves. That's why we chose the Texas Instruments 5TI™ programmable controller over relays.

"The 5TI cost about the same as a relay logic system. But we realized substantial savings with the solid state 5TI because we could avoid the complex hard wiring that relay systems require.

"What's more, the 5TI is easy to use. Our customers can change our palletizer's pattern forming operation just by punching a few buttons. They can troubleshoot the system in minutes. And they can rely on the 5TI to be virtually maintenance free."

The 5TI programmable controller is helping all kinds of manufacturers save money and keep their customers happy. We'd like to demonstrate what it can do for you at a free seminar we're holding in your area.

Just send us the card next to this page, telling us when you'd like to attend. If the card's already been mailed, call us at (617) 222-2800, or write us at Texas Instruments Incorporated, Industrial Controls Marketing, Mail Station 12-38, Attleboro, MA 02703.

The 5TI.
Think of it as a component.

TEXAS INSTRUMENTS
INCORPORATED

CIRCLE NO. 35 ON READER INQUIRY CARD

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Learn all about the 5TI in one of these cities.

FEBRUARY
- ☐ CO, Colorado Springs (Feb. 16)
- ☐ CT, Hartford (Feb. 22)
- ☐ FL, Jacksonville (Feb. 16)
- ☐ FL, Miami (Feb. 23)
- ☐ IL, Chicago (North) (Feb. 16)
- ☐ MA, Boston (Feb. 28)
- ☐ MI, Detroit (Feb. 24)
- ☐ MI, Pontiac (Feb. 17)
- ☐ MN, Minneapolis (Feb. 28)
- ☐ MO, Kansas City (Feb. 22)
- ☐ NH, Manchester (Feb. 16)
- ☐ NJ, Princeton (Feb. 21)
- ☐ OH, Mansfield (Feb. 22)
- ☐ TX, San Antonio (Feb. 21)

MARCH
- ☐ CA, Los Angeles (Mar. 2)
- ☐ CA, San Francisco (Mar. 1)
- ☐ CA, San Francisco (Mar. 28)
- ☐ CO, Denver (Mar. 23)
- ☐ CT, Hartford (Mar. 14)
- ☐ CT, Waterbury (Mar. 8)
- ☐ FL, Miami (Mar. 28)
- ☐ GA, Atlanta (Mar. 14)
- ☐ IL, Chicago (Mar. 15)
- ☐ IN, Ft. Wayne (Mar. 7)
- ☐ MA, Boston (Mar. 16)
- ☐ MD, Baltimore (Mar. 15)
- ☐ MI, Bay City (Mar. 10)
- ☐ MI, Grand Rapids (Mar. 3)
- ☐ MN, Minneapolis (Mar. 30)
- ☐ MO, Kansas City (Mar. 23)
- ☐ MO, St. Louis (Mar. 7)
- ☐ NC, Charlotte (Mar. 6)
- ☐ NY, Rochester (Mar. 30)
- ☐ NY, Westbury (Mar. 22)
- ☐ OH, Akron (Mar. 1)
- ☐ OH, Cleveland (Mar. 15)
- ☐ OH, Dayton (Mar. 9)
- ☐ Ontario, Toronto (Mar. 15)
- ☐ PA, Philadelphia (Mar. 21)
- ☐ PA, Pittsburgh (Mar. 23)
- ☐ TN, Knoxville (Mar. 22)
- ☐ TX, Corpus Christi (Mar. 8)
- ☐ TX, Dallas (Mar. 14)
- ☐ TX, Houston (Mar. 22)
- ☐ WA, Tacoma (Mar. 7)
- ☐ WI, Milwaukee (Mar. 16)

APRIL
- ☐ CA, Anaheim (Apr. 6)
- ☐ CA, San Francisco (Apr. 11)
- ☐ CT, Greenwich (Apr. 26)
- ☐ CT, Hartford (Apr. 20)
- ☐ CT, New Haven (Apr. 5)
- ☐ FL, St. Petersburgh (Apr. 5)
- ☐ GA, Atlanta (Apr. 19)
- ☐ IL, Chicago (Apr. 6)
- ☐ IN, Columbus (Apr. 12)
- ☐ LA, Baton Rouge (Apr. 21)
- ☐ LA, New Orleans (Apr. 18)
- ☐ MA, Boston (Apr. 25)
- ☐ MI, Detroit (Apr. 21)
- ☐ MI, Grand Rapids (Apr. 14)
- ☐ MN, Minneapolis (Apr. 26)
- ☐ MO, Kansas City (Apr. 18)
- ☐ MO, St. Louis (Apr. 4)
- ☐ NC, Greensboro (Apr. 20)
- ☐ NH, Manchester (Apr. 19)
- ☐ NJ, Morristown (Apr. 12)
- ☐ NY, Buffalo (Apr. 20)
- ☐ NY, Syracuse (Apr. 6)
- ☐ OH, Cincinnati (Apr. 13)
- ☐ OH, Cleveland (Apr. 25)
- ☐ OH, Lorain (Apr. 5)
- ☐ OH, Toledo (Apr. 19)
- ☐ OK, Tulsa (Apr. 11)
- ☐ Ontario, Toronto (Apr. 12)
- ☐ PA, Easton (Apr. 11)
- ☐ PA, King of Prussia (Apr. 4)
- ☐ Quebec, Montreal (Apr. 19)
- ☐ SC, Greenville (Apr. 4)
- ☐ TN, Johnson City (Apr. 5)
- ☐ TN, Nashville (Apr. 19)
- ☐ TX, Austin (Apr. 11)
- ☐ TX, Freeport (Apr. 6)
- ☐ TX, Houston (Apr. 4)
- ☐ TX, Waco (Apr. 20)
- ☐ VA, Charlottesville (Apr. 12)
- ☐ VA, Norfolk (Apr. 19)
- ☐ WI, Madison (Apr. 13)

My application for the 5TI would be: ☐ in equipment we manufacture for sale.
☐ in equipment we use in-plant.

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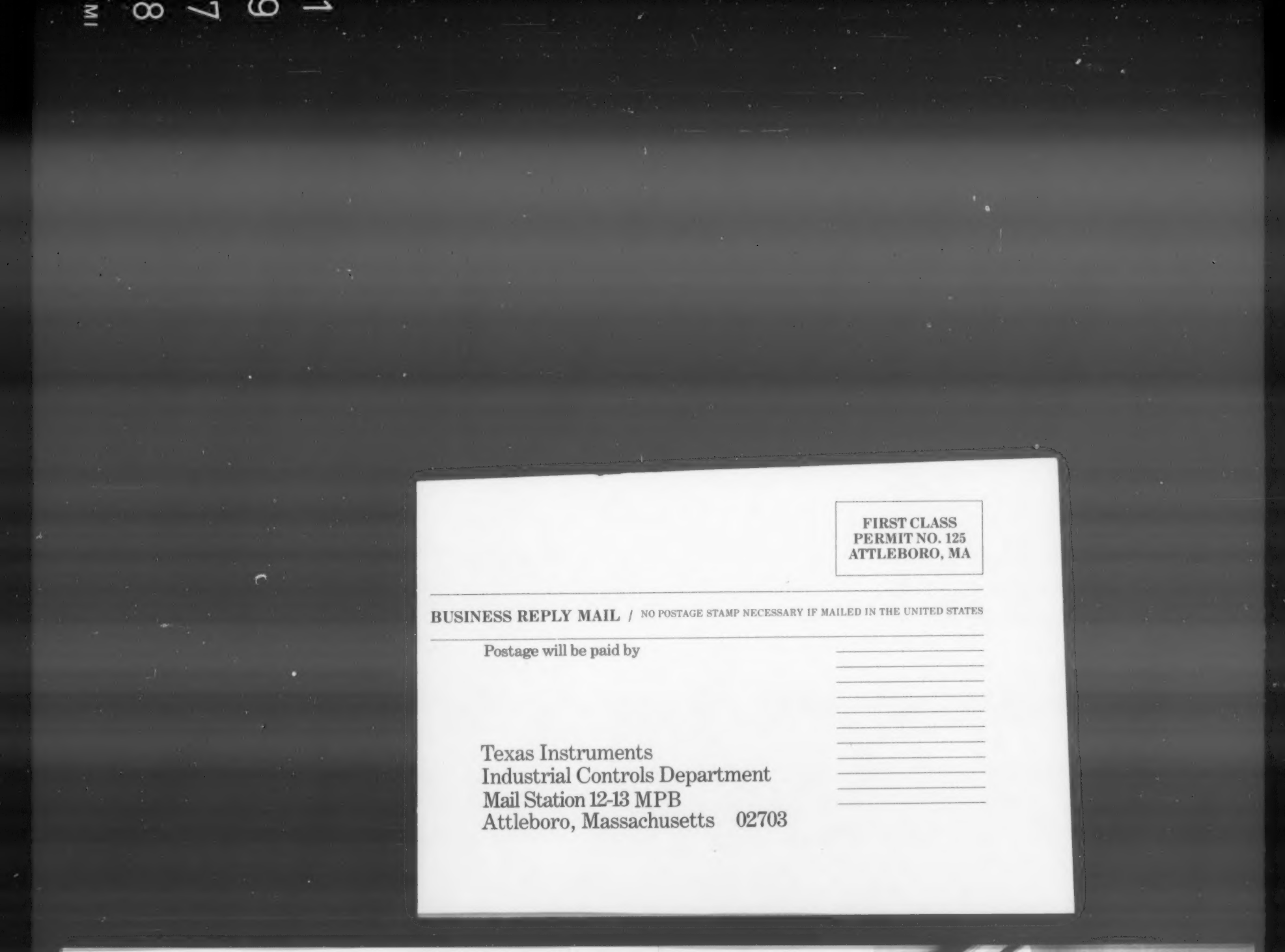
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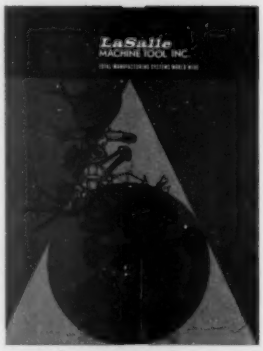
Modicon's new Model 484 is a full-feature PC priced at $780 in OEM quantities. It can handle from 8 to 521 I/Os and is available with numerous options

(continued)

tinually being made more productive due to software improvements. Industry sales figures indicate growing acceptance, too. In 1977, shipments were approximately $65 million. This year, sales should approach $80 million. And by 1980, PC shipments are projected to reach $100 million.

As a replacement for electromechanical relays, PCs have proven value. They are not a replacement for numerical controls, computerized numerical controls, or computer-based manufacturing systems, but do work effectively in tandem with such systems. The programmable controller should be viewed for what it is: an industrial control system designed for a shop environment that can be programmed and maintained by shop personnel to increase the efficiency of manufacturing operations. *BDW* □

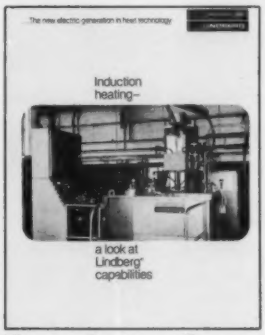
Useful Literature



Development of a total manufacturing system, either automated or non-automated, is discussed in a 12-page brochure available from LaSalle Machine Tool Co.
Circle 699.

A total manufacturing system manufacturing connecting rods is described in a single-page bulletin.
Circle 700.

Capabilities of induction heating systems for modern heat treating applications are described in a 6-page brochure offered by Lindberg Sola Basic Industries.
Circle 706.



Vaccum heat treat furnace systems, their advantages, and their application capabilities are described in a 6-page brochure.
Circle 707.

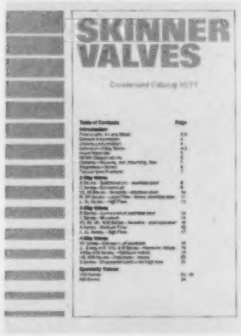
Induction melting furnace systems are described in a 6-page brochure.
Circle 708.

Rotating aluminum reverberatory melting furnaces are described in a 4-page brochure.
Circle 709.

Electric reverberatory furnaces for melting and holding aluminum are described in a 4-page brochure.
Circle 710.

Programmable controllers, the industrial front end for computers, are discussed in a 6-page technical paper originally presented to the Numerical Control Society and available from Gould, Inc.
Circle 711.

Programmable controller capabilities are discussed in a 6-page paper.
Circle 712.



Flow charts for air service and water service precede a listing of its most popular solenoid valves in a condensed 24-page catalog offered by Skinner Valves.
Circle 702.

A coil-to-blanks computer program designed to assist in the conversion of coiled metal to sheets and blanks is described in a 4-page brochure available from Cincinnati Inc.
Circle 729.

A slitting program designed to reduce the amount of scrap produced in the coil slitting process is described in a 4-page brochure.
Circle 730.

A coil width optimization program designed to select the optimal coil sizes to be stocked for a production cycle is described in a 4-page brochure.
Circle 731.

A computer numerical control designed to provide the machine operator with better control of the machine is described in a

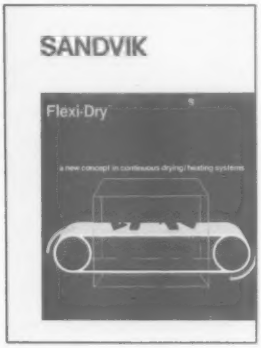
(continued)

Useful Literature

(continued)

4-page article by the Numerical Control Society and available from Vega Servo-Control, Inc.
Circle 703.

CL-Data input for computer numerical control systems, and its effect on post-processors, is discussed in a 12-page paper.
Circle 704.



Continuous drying and heating systems for continuously processing materials are described in a 4-page brochure by Sandvik Conveyors, Inc.
Circle 705.

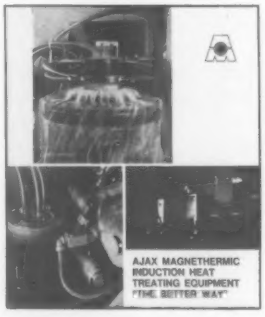
High performance 2-stage directional control valves are shown, with features and benefits, in a 4-page bulletin offered by Sperry Vickers.
Circle 720.

Hydraulic motors for application in high performance machinery, and including vane and piston types, are described in an 8-page brochure.
Circle 721.

Flow rate control valves are described in a single-page flyer.
Circle 722.

Glycerine-filled pressure gages are described in a single-page flyer.
Circle 723.

Computer numerical controls, applicable to a wide range of production equipment and machines, is described in an 8-page brochure offered by Giddings & Lewis Electronics Co.
Circle 701.



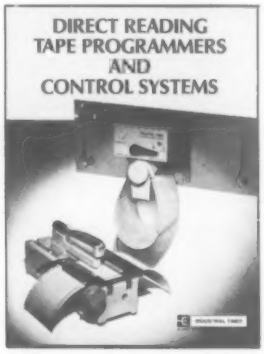
Induction heat treating equipment for progressive and static operations, as well as fixtures and accessories, are described in a 12-page brochure available from Ajax Magnethermic Corp.
Circle 724.

Induction heating for hot working ferrous metals is described in a 12-page brochure.
Circle 725.

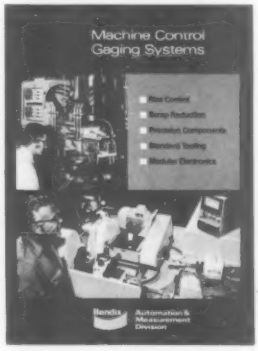
Low frequency induction melting of nonferrous metals is described in a 12-page brochure.
Circle 726.

Induction heating nonferrous metals for tubing extrusion operations is described in a 12-page brochure.
Circle 727.

Induction heaters for large cast slabs are described in a 14-page brochure.
Circle 728.



Direct reading tape programmers and control systems are described in an 8-page brochure offered by Industrial Timer Corp.
Circle 736.



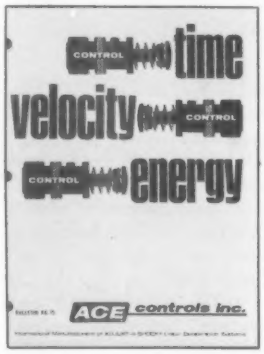
Machine control gaging systems for size control during machining are described in a 16-page brochure available from Bendix Automation and Measurement Div.
Circle 737.

Layout machines with three-axis capability are described in a 12-page brochure.
Circle 738.

Electron-beam heat treating techniques offering excellent control over the physial properties of materials are discussed and shown in a 32-page paper ofered by Leybold-Heraeus Vacuum systems Inc.
Circle 715.

Direct drive rotary vane pumps for use in vacuum systems are described in a 20-page brochure.
Circle 716.

Vacuum technology is discussed in a 16-page booklet, showing quantities, symbols, and units frequently used in vacuum applications.
Circle 717.



Application of linear deceleration systems to industrial equipment is described in a 12-page brochure offered by Ace Controls Inc.
Circle 732.

A sound deadening shock absorber for metalworking equipment, including presses, is described in a single-page bulletin.
Circle 733.

Planning Provides Productivity

Careful, methodical planning is a vital necessity to provide maximum efficiency and utilization of new stamping presses

Planning is the basic contributing element in highly successful stamping operations, regardless of company size or products produced.

Although planning procedures may differ widely, the objectives remain common. Essentially, the goals would include a productivity improvement, efficient production of a new product, or a cost gain by making stampings rather than buying. However, sound planning can contribute to additional benefits including higher quality, increased capacity, reduced handling, capability to produce larger stamped components, reduced scrap, etc., from new stamping presses.

Successful planning starts with recognizing several basic factors which contribute to maximum stamping efficiency. Although the press is the most vital part of a stamping operation, other factors contribute to or limit its productivity, and planning is what ties it all together.

Some of the most sophisticated and successful planning procedures are used by the automobile manufacturers. Their astute planning is necessitated by large multi-plant operations, widely varying product mix, numerous materials processed, and annual model changes.

Ford Motor Co.'s Metal Stamping Division operates eight domestic plants housing over 600 major stamping presses. Plant Operations Manager James Dillon says: "In addition to large programs, some new presses are bought each year to upgrade our facilities. We are presently planning for several large new presses for our frame plant.

"The auto industry is in a unique position because few contract stampers are equipped to produce large body stampings. Huge presses and dies, along with special material handling and shipping facilities, are required to produce and avoid damage to the stamped components. We must plan so we can utilize our stamping presses as efficiently as possible."

Successful planning starts with recognizing several basic factors which contribute to maximum stamping efficiency

Planning for new stamping presses ranks among the critical functions at General Motors Corp.'s Fisher Body Div. which has 241 major lines consisting of 1775 major presses. Donald W. Ableson, engineer-in-charge of facilities planning engineering, reports: "Our initial planning for new presses is based on a five-year corporate sales forecast. These plans are updated until the critical time approaches for ordering new equipment. For example, our ordering plans for a 1980 volume increase are now being finalized.

"We plan for maximum stamping flexibility; that's the name of

Fisher Body's James Barton, administrative engineer (right), and Don Abelson, engineer-in-charge, discuss a proposed storage rack system

FORMING

our game. The objective is to plan for presses needed within the next five years, and to attempt to assure they'll remain useful for the next 20 years.

"Stamping operations and planning procedures are becoming more sophisticated. Previously, low carbon steels were used predominantly, and we were acquainted with their forming characteristics. Today, the expanded use of high strength steels and aluminum are influencing factors in press planning procedures."

We plan for maximum stamping flexibility; that's the name of our game

The Plan. Regardless of the company size or product line, the following pertinent factors should be considered when planning for new stamping presses:

—Productivity required
—Stamping capacity needed
—Materials to be formed
—Equipment developments which can be utilized
—Methods
—Safety requirements
—Energy implications
—Shipping
—Scrap handling
—Press selection

Productivity. An overall evaluation of the existing stamping operation is basic to planning for maximum productivity from new presses. Frequently, the evaluation reveals possible alternate approaches, and opportunities to institute improvements in existing facilities.

Sound planning may indicate that switching jobs between presses will afford the opportunity to purchase a different press than originally considered or preclude the need for a new press. The benefits may include improved overall productivity, flexibility, or a reduction in the number of die changes required. A bottleneck operation may be disclosed which can be alleviated with a new press. Utilization of recent technological developments can also contribute to increasing productivity from new and/or old presses.

Ford's Dillon reports a significant productivity improvement via press planning. He states: "Productivity increased 30 percent in one stamping plant when a 'boat anchor' draw press was replaced. A major program was anticipated to increase the line's capacity; however, a planning investigation indicated a single draw press replacement would provide the productivity increase."

Ableson of Fisher Body adds: "Productivity developments are an influencing factor in the press planning function. It pays to investigate the available technological developments in the early planning stages. Today's replacement for a 20-year old press offers faster operation, improved feed mechanisms, and other features which provide significant productivity gains."

The ideal stamping capacity planning should provide a balanced five-day work week

Stamping Capacity. Stamping capacity refers to the productive hours available from stamping presses. Usually, the investment in new presses is expected to fulfill the present and future capacity requirements. However, determining future capacity needs is extremely difficult, particularly when future part designs are unknown.

Planning the capacity for a new stamping plant is relatively straight forward and is based on the variety and production volumes of stampings to be produced. Planning the capacity for a volume increase in an existing plant can present some interesting opportunities. For instance, a new press with a slightly larger bed, higher tonnage, greater shut-height, and/or a variable speed drive can afford a number of advantages and perhaps eliminate that "problem job" in nearly all stamping plants.

Using a three dimensional model, Ford's Dillon points out some of the features desired in a new stamping press

"Stamping capacity must be considered carefully and planned wisely," offers Dillon. "Actually, the ideal stamping capacity planning should provide a balanced five-day work week, in contrast to some presses running five and others running seven days a week. It's always better to have a little extra capacity than not enough.

"Our fender and quarter panel operations required a capacity increase. Consequently, a new 120-in. press line was planned and is now being installed."

Regarding stamping capacity, Ableson adds: "Our capacity plans are based on the number of press hours required per model. Additionally, die tryout hours and other non-productive requirements are included in the total capacity requirements.

"Contract shops don't have the huge presses to try out roof, quarter panel, or floor pan dies. Consequently, we are forced to use production presses for die tryout, and that time adds to capacity requirements.

Materials. Materials have become a key factor in press planning procedures. A lot of activity is taking place in the auto, truck, appliance, farm equipment, and related industries involving material changes, substitutions, and material developments. The industry-wide trend to conserve energy and weight is leading to wider use of high strength low alloy steels, aluminum, and various plastic materials. At the same time an effort to improve corrosion resistance finds expanded applications of galvanized and stainless steels.

Compared to more conventional steels with known characteristics, HSLA steels require higher forming tonnage and have different spring back features. Aluminum is soft and forms easily, but presents other problems not associated with steel. Stamping dies and the aluminum sheet must be maintained exceptionally clean to keep dirt or foreign material from impinging on a part's surface. Additionally, soft aluminum material nicks, scratches, and dents more easily than steel, necessitating careful handling in and out of presses, during in-process handling, and shipping phases.

Equipment Developments. Press planning procedures demand a complete investigation of stamping developments. For example, electronic stock feeds, power slide adjustments, quick change dies, adjustable speed drives, and other similar features provide significant benefits for specific applications.

Emphasizing the importance of keeping abreast of equipment developments, Dillon said: "We maintain a constant interchange of information with major press builders. They inform us of their developments, and we advise them of our changing needs, experience, and ideas.

"Recent developments in the stamping press industry have been in the areas of controls, lubrication, die setting, overload protection, and improved electrical system reliability. In my opinion, the overload protection is an excellent feature in conjunction with automatic press operations. In cases where an automatic feeder feeds two parts, or the unloader fails to remove a stamping from the die, the overload device stops the press at a prescribed safe overload avoiding costly smash-ups causing broken crankshafts, etc."

We maintain a constant interchange of information with major press builders

Methods. The method of producing stampings deserves evaluation during the planning stages. For example, coil versus sheet material makes a vast difference in the operation. The type of dies, operating controls, part discharge, and other factors also must be determined in the planning stage.

When a blanking operation is being planned for relatively simple flat blanks, it's worthwhile to evaluate the actual need for a press. Today's automatic shears offer numerous advantages; lower initial cost heads the list. Additional benefits include: high production rates, maximum flexibility, minimal floor space requirements, and low cost tooling.

Employee Safety. Fail-safe press controls, adequate safety guards, and operator protection must be included in the planning proce-

(continued on page 117)

PRESS PLANNER CHECKLIST

PRODUCTIVITY	—recheck existing press loading —eliminate production bottlenecks —investigate technological developments
STAMPING CAPACITY	—include die changeover time —utilize optional features to maximize capacity
MATERIALS	—higher tonnage required for HSLA steels —aluminum requires extra cleanliness
EQUIPMENT DEVELOPMENTS	—investigate and use press and related equipment features to obtain maximum benefits
METHODS	—consider all possible alternate methods: Is a new press really necessary?
SAFETY REQUIREMENTS	—the new press system must conform to all mandated employee safety requirements
ENERGY IMPLICATIONS	—investigate the simplest energy conservation approaches
SHIPPING	—examine packing and racking to minimize freight and shipping costs
SCRAP HANDLING	—scrap must be discharged from die areas —consider provisions to segregate materials
PRESS SELECTION	—analyze reliability, delivery, maintenance, repairs, in-house repair capability when choosing a specific make of press

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CIRCLE NO. 37 ON READER INQUIRY CARD

(continued)

dure. The plant location of new presses should be planned carefully to minimize noise transmission and afford efficient handling of raw material, coil loading, press repair and maintenance, and die changeover in a safe environment.

Equipment not operating productively, or which has not produced a part in the last ten minutes, should be shut off

Energy. Due to the critical shortages and high costs, energy conservation has become a major consideration in planning for presses. Small things, like planned access for industrial trucks, minimizes their service time and saves fuel. Simple electrical devices will stop accessory conveyors, part feeders, ejectors, etc., when a press is shut down.

Ford's Dillon proclaims: "Equipment not operating productively, or which has not produced a part in the last ten minutes, should be shut off. We've installed electrical cut-off devices on numerous presses and conveyor systems which conserve energy during shift breaks, lunch periods, and other downtime.

"Keeping with energy conservation, some of our stamping plants are recycling heat generated by press underdrive mechanisms. A simple system merely forces the heat from the basement to the working area."

Shipping. Rising freight costs have made shipping a notable factor in press planning particularly for multiple plant operations. Consequently, planning must determine the best plant for the new presses based on production feasibility and shipping economy.

If rail shipping is to be used, load density is an important economic consideration. Planning should be based on the use of full railroad cars; therefore, packing or racking of the stampings is extremely critical. Storage space ahead of shipping may also be needed to facilitate shipping methods.

According to Ableson: "Our shipping procedures require careful planning due to the production methods and model mix. We don't have dedicated press lines for Chevrolet, Cadillac, Pontiac, Oldsmobile, or Buick components. Tooling is changed over to produce designated parts as scheduled. Consequently, we plan to maintain a five-day bank of stamped components ahead of shipping to provide an efficient press changeover cycle."

Scrap Handling. Economic conditions have made scrap handling an important economic consideration. Sometimes considered a necessary evil, scrap handling must be planned to prevent equipment stoppages and, where necessary, to segregate materials to provide the maximum salvage return.

Positive scrap discharge mechanisms eliminate scrap accumulation in the die area and subsequent press stoppages. Chutes properly inclined or power conveyors move scrap from the press areas. Where scrap tubs are used, allow adequate space for their removal and replacement without interferring with the press operation.

At Fisher Body, scrap handling is posing a significant challenge. Ableson claims: "The addition of galvanized steel and aluminum in stamping plants complicates scrap handling and processing. The different materials must be segregated to obtain maximum salvage value.

"Only our newest plants—Kalamazoo and Lordstown—are equipped with dual scrap collector systems; other plants have a single system. And, we are being informed that aluminum scrap must also be segregated by alloy; a very difficult and costly chore. However, the $30 per ton difference between prime aluminum and contaminated scrap is an inducement to investigate improved handling and processing methods.

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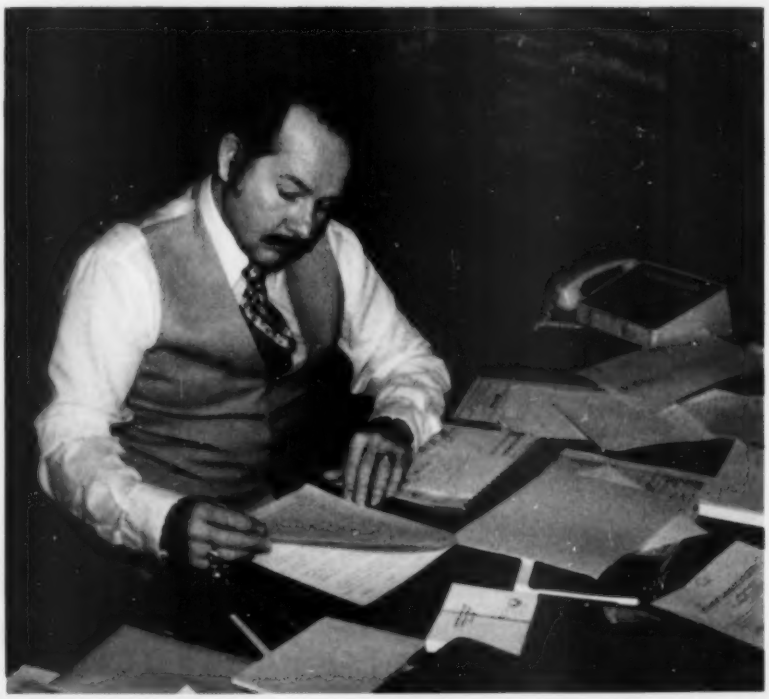


Marvin Gillum, Gilco Industries Inc., methodically reviews specifications for a new press

multi-operation press work

with large, automated straight sides

solves the cost problem

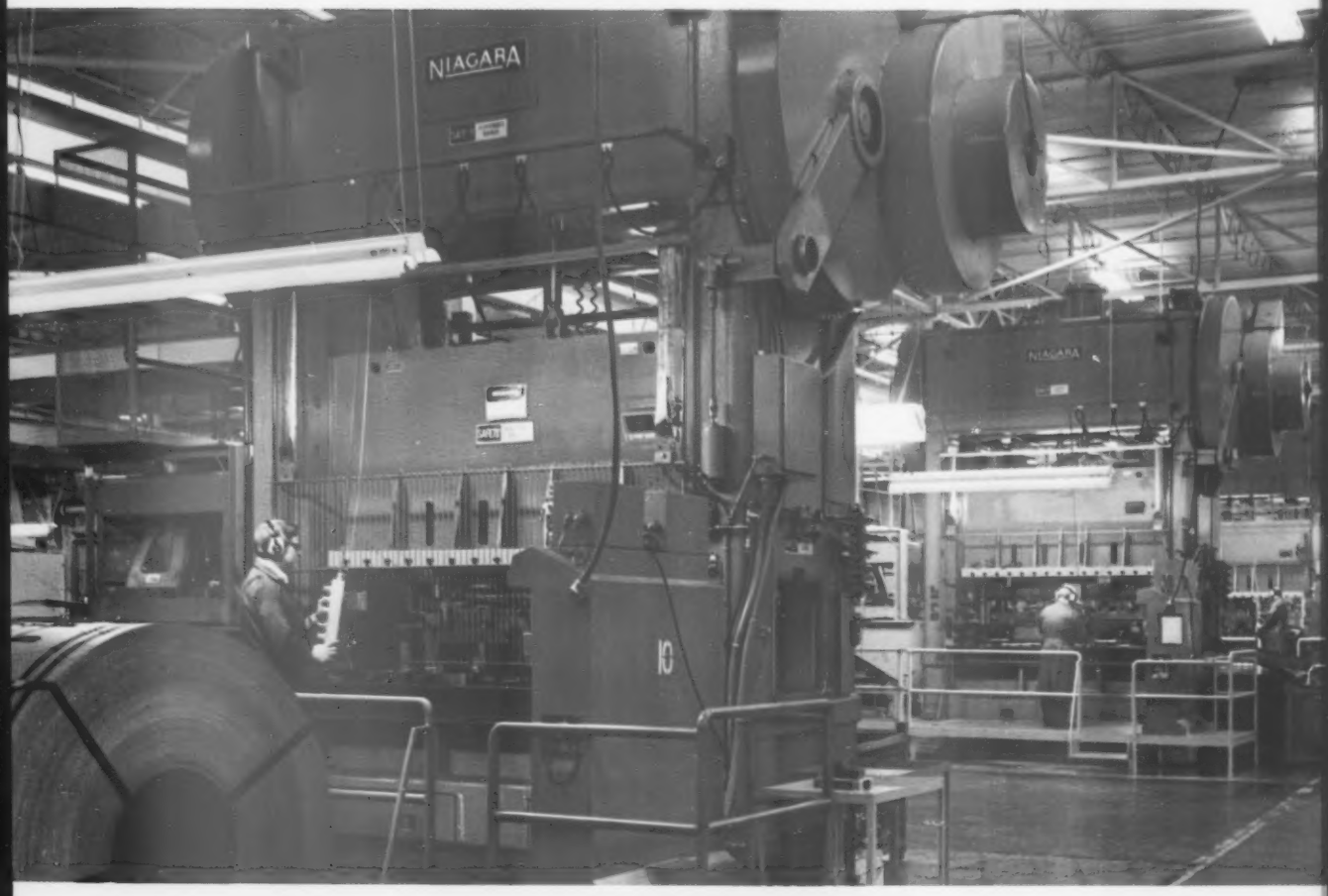
for custom stamping house

The three, 400-ton, Coil Fed, Niagara Automated Progressive Die Presses pictured here are part of this large Detroit job stamping firm's solution to combat spiralling production costs. They are members of a sizable Niagara cost-attack team selected to replace single operation presses with large, multi-operation Straight Sides.

The clear-cut objective of cost reduction to remain competitive is meeting with eminent success in a number of ways: One large press now does the work of several individual stage presses, producing a finished part with each cycle. Parts inventories, therefore, have been cut to the bone, so less money is being tied up in them. Automatic press features and progressive die tooling have appreciably reduced manual material handling. More parts per man hour multiplies the manpower yield of each operator. The multi-purpose nature of this press equipment makes it easily adaptable to multitudes of operations, enhancing greatly the versatility of the shop.

Quite possibly, Niagara can reverse your cost trend, too. Offering the industry's largest selection of Straight Sides—eccentric shaft, crank type, or eccentric geared up to 1250 tons—supplemented by numerous coil processing innovations, such as Dyna-Feed and Mod-U-Loop Control, all built into one, completely co-ordinated, perfectly mated press package, Niagara can prescribe and deliver exactly what your diagnosis indicates.

You'll find it profitable to consult Niagara and Niagara likes to be consulted. Request literature, too. Niagara Machine & Tool Works, P.O. Box 475, Buffalo, N.Y. 14240.



NIAGARA

America's most complete line of metalworking equipment

CIRCLE NO. 38 ON READER INQUIRY CARD

(continued)

"We solved our aluminum scrap handling situation with an electrical reversing system on the underfloor cross feeeding conveyors," Dillon reports. "Normally, the cross feed conveyors transport steel scrap to a main conveyor. When aluminum sheet is being stamped, the cross feed conveyor is reversed to transport scrap into individual gondolas."

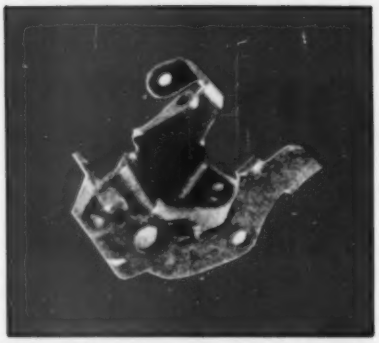
Press Selection. Putting the actual press selection last in the planning sequence affords several advantages. Basically, the thought, effort, decisions, and ideas generated reaching the previous decisions provide an excellent foundation for selecting a specific make of press.

One of the most important factors in the selection of a new press is reliability. The original cost of a highly-reliable press is long forgotten when it continues to operate year after year.

The plan doesn't stop with the purchase order . . . it must allow time for building, delivery, installation, and tryout of new presses. Although leadtime depends on market conditions, delivery of large presses usually ranges up to 18 months. Consequently, planning for and ordering new presses should be completed as far in advance of scheduled production dates as possible. Ordering dies and presses at the same time—not necessarily from the same source—also avoids a delay in the tryout process.

The selection of a specific make of press demands serious consideration of maintenance and repairs. These factors are major contributors to downtime; therefore, the press builder's reputation and personal experiences bear investigation. Of equal importance, various makes of presses should be evaluated in terms of maintenance and repair frequency, availability of repair parts, ease of repair, and the capability of plant personnel to perform repairs.

Ford's Dillon says: "The actual selection of specific presses is a competitive procedure based on an evaluation of features, delivery, past experiences, and other important facts. In spite of the general consensus, the lowest price quote is not automatically awarded a purchase order. The user plant experience influences the make of press that will be purchased.



One of the more complex carburetor parts produced at Gilco Industries

"The plant documentation for a specific make of press may include past experience with a particular make, operator preference, maintenance familiarity, repair frequency, and other pertinent points. The plant may also reject a new feature or type of control due to lack of experience. We simply can't afford to try new ideas on production facilities. The divisional production laboratory is equipped to perform all types of tests and report back to the plants.

"We maintain a large inventory of critical spare press parts; it's a vital factor in maintaining maximum press utilization and productivity. I'd hate to experience the effects of a major press line being down for an extended time period due to the lack of a part."

Smaller Stampers. Smaller stampers may follow a variety of brief or simplified planning and purchasing procedures. Depending on the company size and/or number of plants, the president, designated officer, plant manager, or a combination of these people are generally responsible for the equipment planning and purchasing functions.

MSM Industries, Inc., North Reading, MA, typifies a contract shop whose president is the decision maker. President Leonard Sebell strives to maintain the most highly efficient and productive facilities.

Sebell devotes considerable time to the planning and evaluation of new equipment. Several months were consumed last year planning, evaluating, and buying a new turret punch. This activity involved a methodical evaluation of the various make turret punches available and an accurate comparative analysis of their features.

"After the groundwork was completed," says Sebell, "I selected a new type Di-Acro QCT-20NC turret punch, and visited the builder to watch the machine in operation. It was put through its paces and performed exceptionally well. Therefore, I bought the machine."

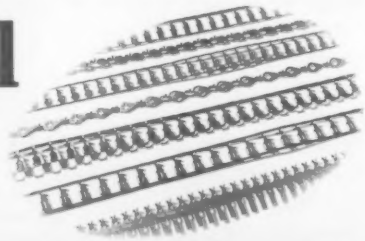
Gilco Industries, Inc., Roseville, MI, represents a contract stamper where the equipment planning function consists of a combined president and committee approach. The president makes the final decisions; however, he solicits technical input from the manager and tool engineer at the plant involved.

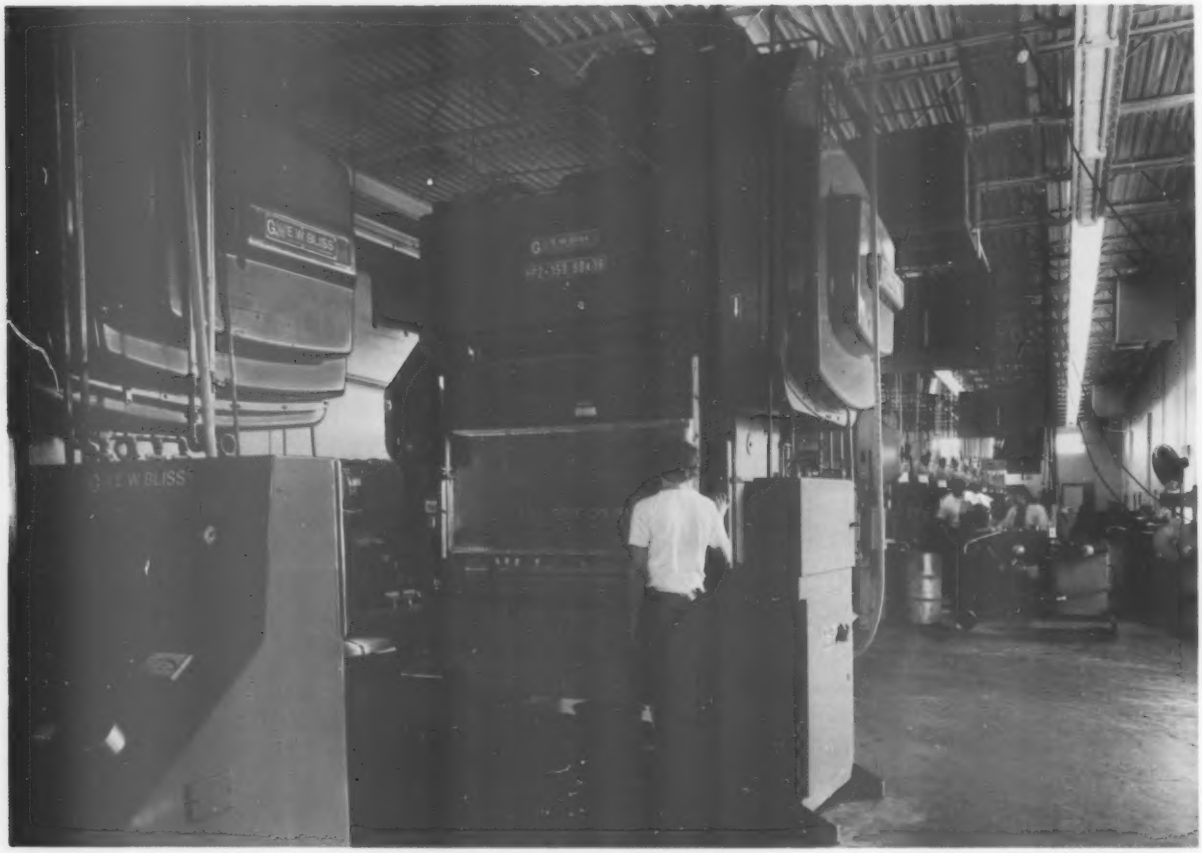
Regarding planning procedures, President E. M. Gillum reports: "Equipment planning has become an important part of our operations. Four new presses were added during the past two years; the latest 200-ton was installed last summer.

"Several primary factors are involved in the planning for new presses. My philosophy is to obtain a contract for the production of parts first, then buy a press if required. Consequently, a minimum of time is available for short range planning. On the other hand, our long range planning keeps us abreast of current and future capacity requirements. For instance, our press utilization is constantly monitored. If the work load for

(continued on page 121)

BLISS "minimal down-time" means PRODUCTIVITY at Interlock Terminal Corporation





Producing over 100 million parts per month demands maximum up-time and full precision performance.

Ask Bob Peterson, president of Interlock Terminal Corporation about Bliss productivity. He will tell you that the success of a precision stamping application hinges on the optimum combination of a precision press and precision dies and tooling.

For over 12 years Bliss presses have continually given Interlock Terminal maximum productivity and extended tool life. The precise gib alignment has resulted in the production of as many as 10 million parts at one time without grinding of their multiple part electrical terminal progressive dies.

Their 15 Bliss high production presses range from 35 ton gap frame to 150 ton double crank, straight sides. These presses are engineered to meet the demands of high volume, close tolerance, progressive die work.

GW

E. W. Bliss Division

Gulf + Western Manufacturing Company
23100 Providence Dr., P.O. Box 999
Southfield, MI 48037 • (313) 424-4303
Telex: 23-0630 Cable—BLISSCO

CIRCLE NO. 39 ON READER INQUIRY CARD

(continued)

150-ton presses approaches production capacity, I initiate the planning of an additional press.

"I may be considering a 150-ton press for the production of a part scheduled to be produced within a few months. Perhaps the plant manager and tool engineer will agree on the bed size, strokes per minute, shut-height, etc., but they may suggest a 200-ton press to alleviate a capacity squeeze.

"Price, delivery, quality, and durability—not necessarily in that order—are primary considerations in the selection of a particular brand of press. We've learned a vast difference exists between the various makes of presses, and I'll never buy one particular make again because it continually broke crankshafts.

"Final planning for the new press includes an accurate recap of each pertinent factor with respect to our planned utilization of the machine. For instance, the method of rating the tonnage is extremely important in our operations. We want the maximum tonnage available before the bottom of stroke; not on the absolute bottom.

"Although we subscribe to sound planning practices and economical equipment purchases, there are times when circumstances alter cases. In 1975, we needed a new 175-ton press in a hurry. Our planning procedures had determined brand 'X'; however, a 36 to 40 week delivery was quoted. Our customer could not wait that long for parts.

"I contacted Rousselle who offered a 12 week delivery. The cost was not the lowest, but it was a high quality press and we needed it fast. Consequently, I bought it. We have since purchased three more Rousselle presses."

Planning is one of the most important products of all stamping operations; it generates more profits. And the fact is, the better the planning, the better the operation and more profitable it will be. *VAW* □

Useful Literature

Plastic injection molding machines ranging from 150 to 1000 tons in clamp capacity, and 6 to 260 oz in shot capacity, are described in a 12-page brochure available from Beloit Corp.
Circle 587.

Drawing compounds are discussed and the factors to consider in selecting the best compound for a given operation are presented in a 4-page brochure offered by Oakite Products, Inc.
Circle 611.

A plastic compression molding press designed for high-accuracy molding of reinforced plastics is described in a single-page data sheet offered by Erie Press Systems.
Circle 610.

Tube and pipe end finishing equipment and tooling are described in a 42-page brochure available from Conrac Corp.
Circle 633.

CNC bending equipment for tube and pipe is described in a 4-page brochure.
Circle 634.

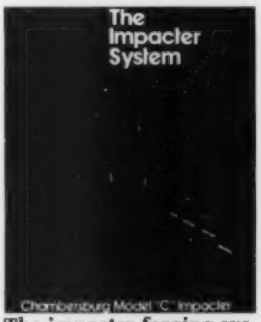
Manual bending machines for small diameter tube and pipe are described in a 4-page bulletin.
Circle 635.

Automatic bending machines for tube and pipe are described in a 4-page bulletin.
Circle 636.

Hydraulic bending machines for large diameter tube and pipe are described in a 4-page bulletin.
Circle 637.

Sheet metal forming data, including basic tests and procedures to determine capacity of sheet material to change shape without wrinkling or beading, is presented in an 8-page brochure by Armco Steel Corp.
Circle 594.

How carbon steel drawability is increased with the Armco cold punch process is discussed in a 6-page brochure.
Circle 595.



The impacter forging system, automatic equipment installations, and application capabilities are described in a 16-page brochure available from Chambersburg Engineering Co.
Circle 618.

Gravity-drop forging hammers with air or steam lift, and the special controls available as well as their outstanding operating features, are described in a 16-page brochure.
Circle 619.

(continued on page 123)

FORMING

We call it MAXI and it is all new. Relying on a half century of experience in building Maxipresses, we maintain our conviction that eccentric drive and tie-rod construction make the most productive and dependable mechanical forging press. We also continue other features proved reliable in production, and now further improved.

Our new MAXI offers the industry two major advantages in press selection:

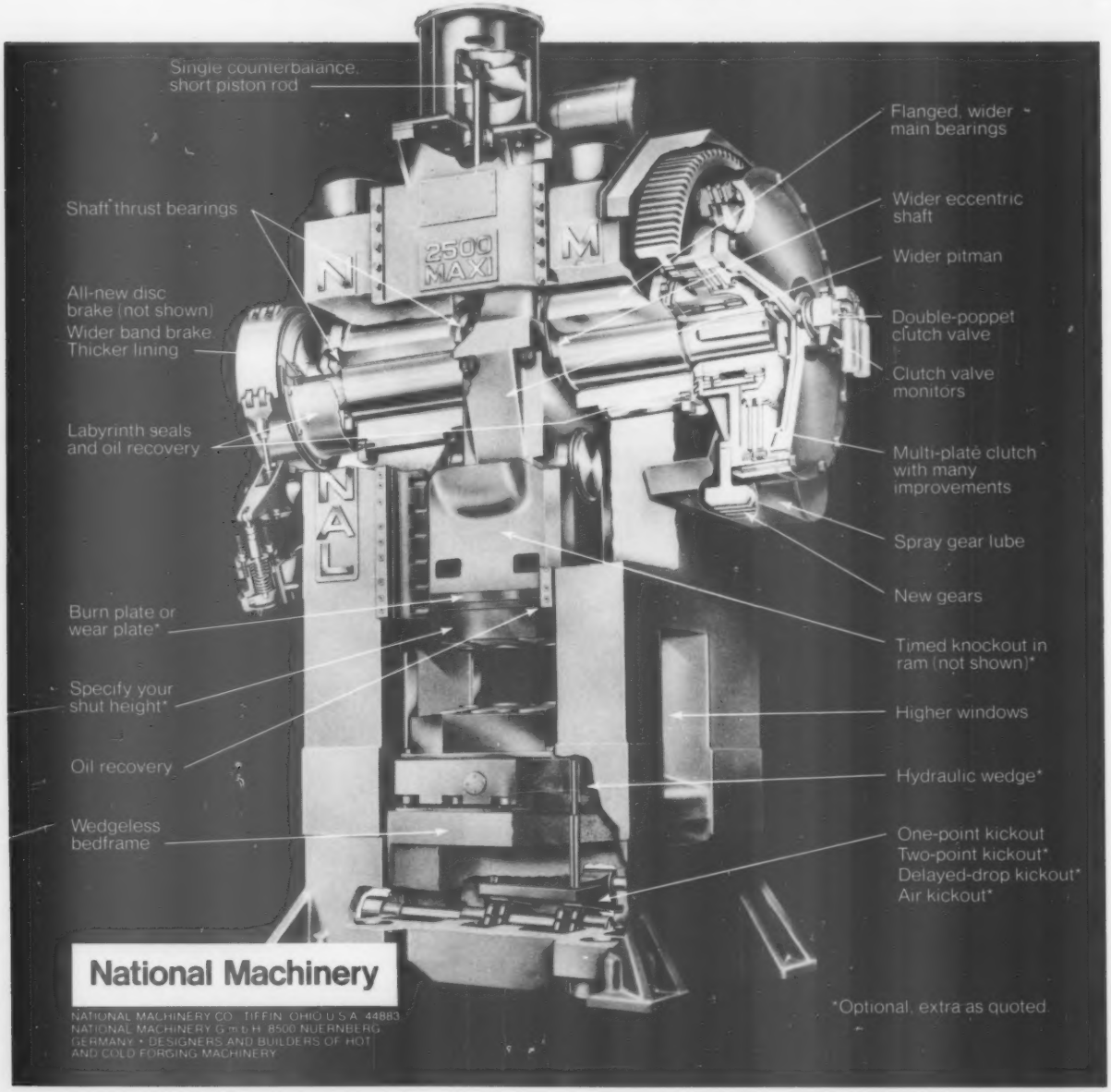
1. A basic press for high performance with minimum investment and quick delivery.

2. A complete line of optional features for improved versatility without penalties in price and delivery time.

Below are some new features.

MAXI

Your new mechanical forging Maxipres



National Machinery

NATIONAL MACHINERY CO., TIFFIN, OHIO U.S.A. 44883
NATIONAL MACHINERY G.m.b.H. 8500 NUERNBERG GERMANY • DESIGNERS AND BUILDERS OF HOT AND COLD FORGING MACHINERY

*Optional, extra as quoted.

CIRCLE NO. 40 ON READER INQUIRY CARD

Useful Literature

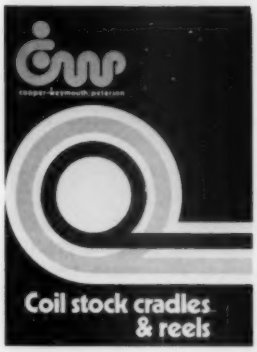
(continued)

The Chambersburg die forger with sequence programming controls is described in a 12-page bulletin.
Circle 620.

A high-speed CNC turret punch press for electronic manufacturing and smaller job shops is described in an 8-page brochure available from Wiedemann Div.
Circle 621.
A two-axis CNC shearing system said to boost productivity while reducing scrap and labor costs is described in an 8-page brochure.
Circle 622.

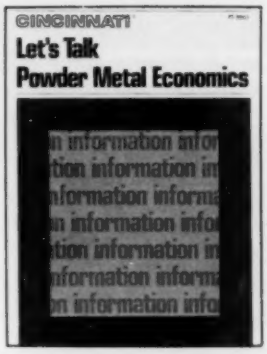
Upset parts and materials, machines for upsetting, and tooling for upsetting are covered in a 24-page brochure available from National Machinery.
Circle 612.

Cold forming extra large parts automatically at high speeds is discussed in a 12-page brochure.
Circle 613.

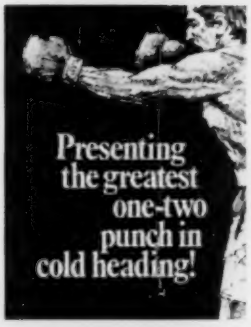


Coil stock cradles and reels for use in metal stamping and forming production are described in an 8-page brochure available from Cooper-Weymouth, Peterson.
Circle 601.
Coil stock feeds, including roll-type and reciprocating air feeds, are described in an 8-page brochure.
Circle 602.

Plastics injection molding machines with mechanical clamp capacities from 75 to 750 tons and shot capacity from 3 to 170 oz are described in a 6-page brochure with a pocket containing a 4-page specifications chart by Farrel Company Div.
Circle 597.
Hydraulic clamp plastics injection molding machines, with clamp capacities from 375 to 3000 tons and shot capacity from 14 to 600 oz are described in a 6-page folder containing a 4-page specifications sheet.
Circle 598.
The USM foam process, its applications and advantages, and the design opportunities it offers are presented in a 12-page brochure.
Circle 599.



An introduction to powder metallurgy processes is presented in a 4-page brochure offered by Cincinnati Inc.
Circle 588.
Die wall lubrication for P/M (powder metallurgy) parts and preforms is discussed in a 6-page brochure.
Circle 589.



Two-blow cold headers with speeds ranging up to 380 parts per minute, and for 3/16, 1/4, and 3/8 in. wire, are described in a 12-page brochure available from Waterbury Farrel.
Circle 590.
Thread rolling machines, including heavy-duty chain feed thread rollers are shown in an 8-page brochure.
Circle 591.

A fourslide forming machine, its basic functions, applications, and tooling are presented in a folder offered by A. H. Nilson Machine Co.
Circle 592.

Injection molding Tenite cellulosic plastics, including the process, equipment, and mold design, is covered in a 62-page booklet by Eastman Chemical Products, Inc.
Circle 614.

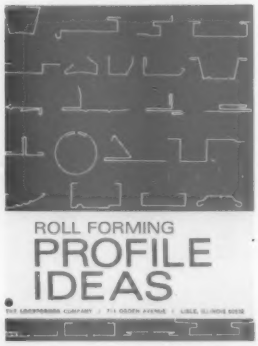
Forging applications of solid state power supplies and temperature controls are discussed in a reprint of a technical paper by Westinghouse Electric Corp.
Circle 623.
Heating for forging, including a review of induction heating approaches, is discussed in a 28-page reprint.
Circle 624.

(continued)

FORMING

Useful Literature

FORMING
(continued)



Roll forming profile ideas, along with job data on more than 130 part profiles, are presented in a 24-page booklet by Lockformer Co.
Circle 625.

Custom stampings, and its equipment and services for producing them to customer order, are described in a 20-page brochure offered by Elco Industries, Inc.
Circle 626.

Engineering information for thread forming and thread cutting screws is presented in a 48-page brochure.
Circle 627.

An NC turret punch press with high productivity and a 20-station tooling changeover is described in a 6-page brochure offered by Di-Acro Div. of Houdaille Ind., Inc.
Circle 615.

An NC turret press checklist for evaluation and justification of NC punching is presented in a 16-page technical bulletin.
Circle 616.

How to compare and select press brakes on the basis of speed, accuracy, and controllability is presented in a 12-page technical bulletin.
Circle 617.

Electric resistance welded tube and pipe mills available in capacities ranging from ½ to 24 in. diameter are shown and discussed in a 24-page brochure of-

THREADERS

On one hand

Hartford Special has the most complete line of high speed thread rollers available... diameters from .027" to 1⅛"...shank lengths from below ⅛" to 8"...speeds up to 1,000 parts per minute.

See that part on the tip of the index finger? They're rolled at 1,000 ppm. on our Triple 0-1000. Or that pipe plug right next to it? That's done at 200 ppm. on our Model 20-225 roller. Or that wheel bolt resting on the little finger? It's threaded and knurled in one pass on our Model 30-180 at 180 ppm.

So, when you're looking for thread rollers, call Bob D'Amore at Hartford Special Machinery Company, (203) 658-7601. College Highway, Simsbury, CT 06070.

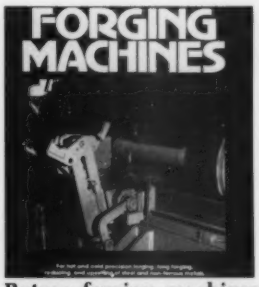
HARTFORD®
HIGH SPEED THREADERS & HEADERS

CIRCLE NO. 41 ON READER INQUIRY CARD

fered by Wean United.
Circle 605.

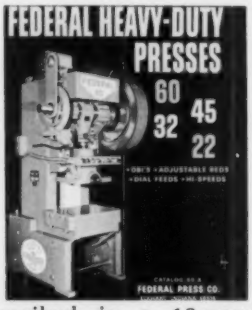
Bar and tube drawbenches and related equipment are described in a 6-page brochure.
Circle 606.

How to specify and buy cold-headed parts, and a review of tolerances, practical shape limitations, and materials, are presented in a 6-page brochure offered by Milford Rivet & Machine Co.
Circle 607.

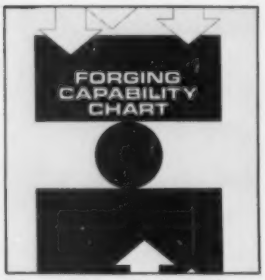


Rotary forging machines for hot and cold forging and upsetting operations are presented in a 12-page brochure available from Fenn Manufacturing Co.
Circle 604.

Heavy-duty presses, including dial feed, OBI, adjustable bed, and high-speed models, are described in a 12-page catalog offered by Federal Press Co.
Circle 638.



Cold extrusion of complex steel parts, such as side gears, pump housings, and bearing cases, is presented in a 20-page brochure offered by Braun Engineering Co.
Circle 629.



The 1978 edition of its Forging Capability Chart (1977 edition shown) listing location and facilities of its members will be made available by Forging Industry Association.
Circle 596.

...OR HEADERS

And on the other

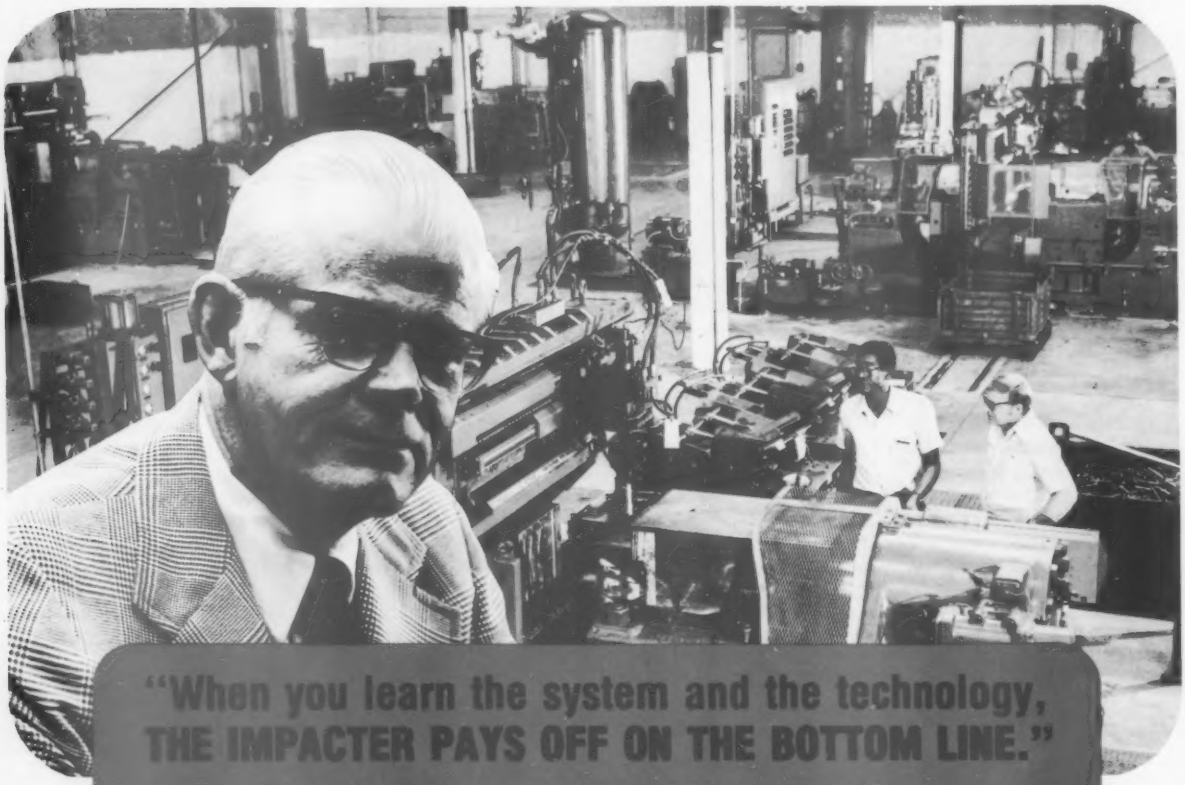
Hartford builds the most reliable high speed headers you can buy for parts through 5/16" diameter.

Take that 5/16" diameter bearing ball on the third finger. That's done on our Model 2-850 at 850 ppm. Or that distributor cap insert in the palm. That runs at 350 ppm. on our Model 3-350. Or that spark plug electrode laying against the thumb. That's produced on our Model 3-500 at 500 ppm.

Hartford headers save time, material and floor space. And all they ask in return is to be fed regularly. So, when you're thinking about cold heading, call Bob D'Amore at Hartford Special Machinery Company, (203) 658-7601. College Highway, Simsbury, CT 06070.

HARTFORD®
HIGH SPEED HEADERS & THREADERS

The drop forge shop of the future is here now!



"When you learn the system and the technology, THE IMPACTER PAYS OFF ON THE BOTTOM LINE."

Leonard Bloomquist, Vice President, Crescent Tool Company, Sumter, SC, Division of Cooper Industries, Inc.

Leonard Bloomquist knows. He has six Impacters in a clean, modern, windowless building of the type that will mark the forge shop of the future. Like other far-sighted executives, he believes that forge shop owners, squeezed between the demands of the market place and the rising costs of labor and ecological regulations, can survive only with the Impacter System. As he says ". . .It's the future of our business."

The future is here now with the Chambersburg Impacter! Combined with an electrical heating installation, the Impacter System heats, transfers and forges in one continuous process. It's an answer to the industry's most pressing problems: productivity, cost reduction and ecology.

Higher Production. The striking rate of the Impacter is 50 to 100% greater than that of conventional equipment and its production approximates that of 2½ standard hammers. Accurate die alignment and automatic unerring stock positioning result in fewer rejects, higher usable production. All combine to achieve more output per man-hour.

Cost Reduction. Experience shows that the Chambersburg Impacter, because of its uniquely efficient "forging in mid-air" principle, uses less energy than drop hammers. In addition, the system can extend the die life by as much as 30%, because die contact is held to milliseconds, dies run cooler and scale drops free.

Ecology and Safety. The Impacter's unique counterblow principle virtually eliminates the shock and ground vibrations normally associated with hammer equipment. Low profile configuration permits Impacter installations in "anti-noise" conditioned buildings and/or those with sound barriers. The operator stands clear of the work area minimizing exposure to hot steel and moving parts.

Most drop forgings made "off the bar" are adaptable to this unique, new production system. Call or write us today. We'll be glad to show you what the forge shop of the future will do.

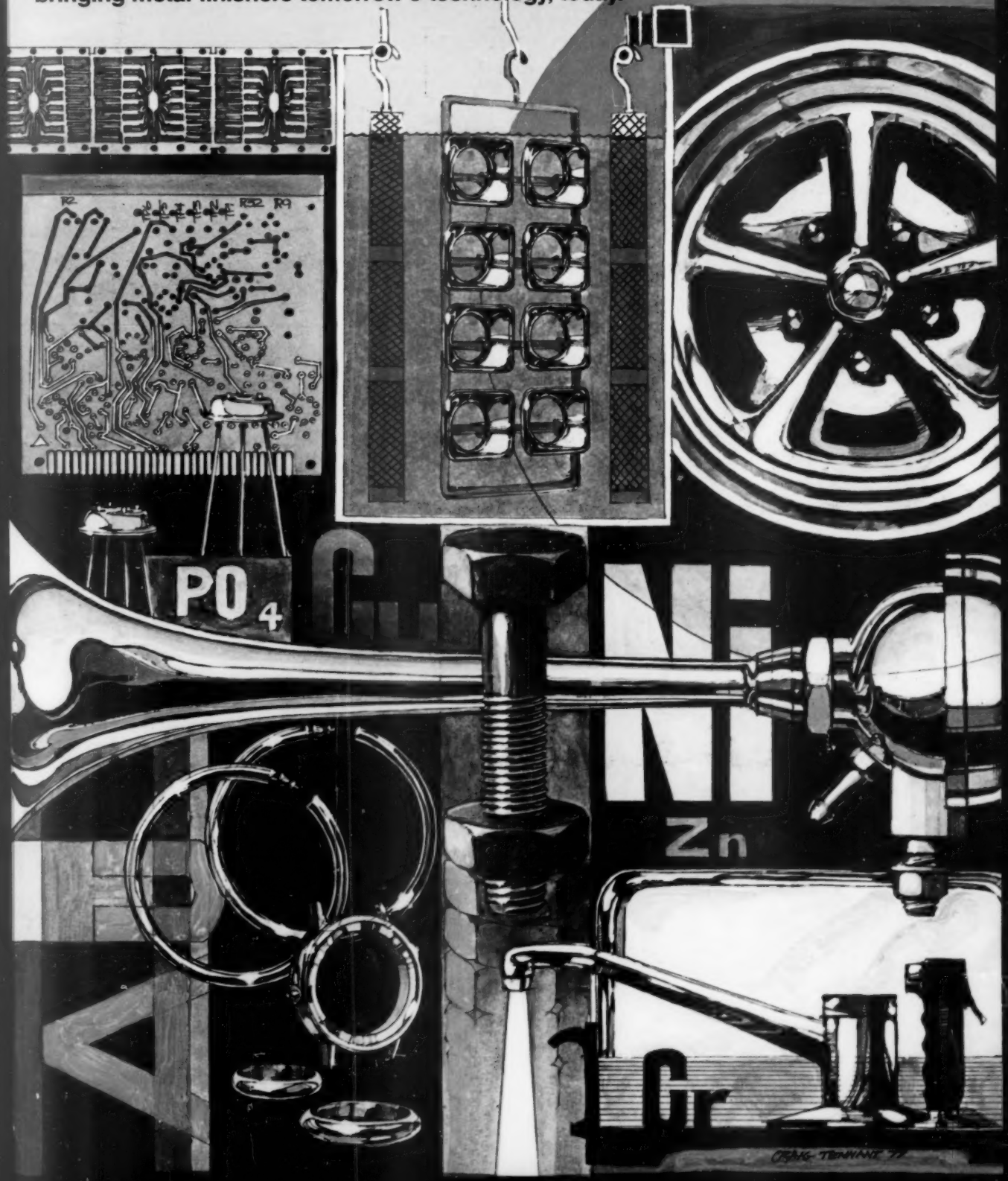
CHAMBERSBURG
ENGINEERING COMPANY
150 Derbyshire Street - P.O. Box 359
Chambersburg, PA 17201 U.S.A. / Phone: (717) 264-7151

CIRCLE NO. 42 ON READER INQUIRY CARD

AUTOMATION

from the Equipment Systems Division of Oxy Metal Industries Corporation

bringing metal finishers tomorrow's technology, today.



Tomorrow's Technology, Today

The Equipment Systems Division of Oxy Metal Industries Corporation draws upon the combined experience of **Udylite, Sel-Rex, and Parker,** the leading companies in their fields, to provide a wide range of specialized high-speed automatic equipment for all types of metal finishing, metal reduction, and electrochemical production. Together, through the Equipment Systems Division of OMIC, these divisions focus more than 60 years of experience toward providing you with tomorrow's technology today.

Already a Generation Ahead...

The Udytrol™ Unified Machine Control, from OMIC's Equipment Systems Division, introduced high-volume, large-scale computerized programming and control to the metal finishing industry. The first fully field-programmable control system for automated hoist lines, the Udytrol control features unlimited programming flexibility, with no tapes to punch and no pins to reset. In computerized finishing, you're already a generation ahead.

Sophisticated Rectifier Designs for More Profitable Operation

A full range of the most technologically sophisticated power conversion equipment is offered by OMIC's Equipment Systems Division, ranging from bench-type single-phase rectifiers for lab and small production work, up to megawatt units for electrochemical production and metals reduction.

Udylite Ultrasil® PC-10: Bench-type, silicon, dual-range DC power and supply designed for lab and small plating operations, featuring operating ease and long, trouble-free performance.

Udylite Miniverter®: Bench-type, single- phase, silicon control rectifier designed for automatic electroplating with precious metals, printed circuits, and other precision plating applications.

Udylite Solid-State Converter (SSC)®: Utilizes advanced techniques in solid state rectification to provide dependable, low-cost DC power. Offers optional air or water cooling.

Udylite SASSC®: Sealed automatic solid-state converter designed for low-cost, full-range control and maintenance-free performance. Compact units are ideal for many applications.

Udylite Megaverter®: Solid-state silicon control rectifiers, currently available up to 5 megawatts, for electrochemical production and metals reduction. Feature patented circuitry for full-range control and maintenance-free performance.

Modular Systems for the Expanding Precious Metals Industry

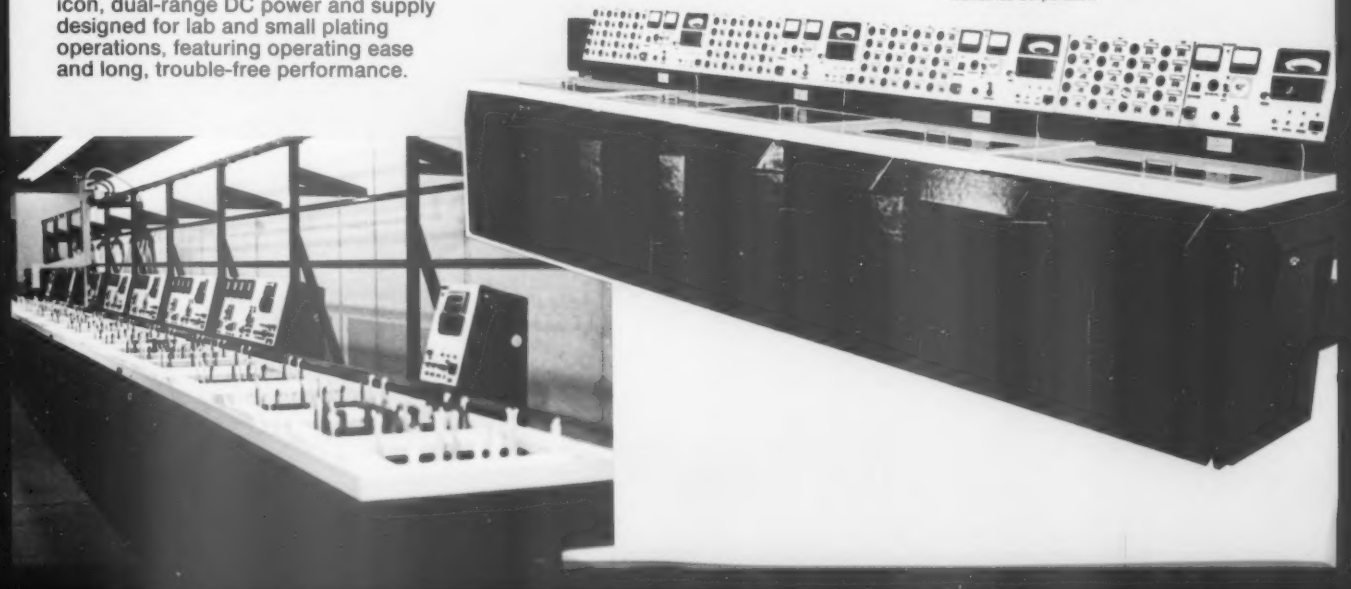
As the leading innovator in the precious metal electroplating industry, Sel-Rex experience has enabled OMIC's Equipment Systems Division to develop a wide range of specialized equipment uniquely suited to the needs of jewelry, decorative, and electronics industry finishers.

Sel-Rex Module-X® Packaged System: Custom designed to fit your application, yet using standard, modular components, to cut costs, be fully flexible to your needs. Power, water supply, drain, and exhaust systems are factory installed and manifolded for easy connection to your plant facilities.

Sel-Rex Module-Matic® Packaged System: With built-in versatility for fully automatic, completely programmable plating, using standardized components for rack or barrel plating to cut your installation and purchase costs. Utilizes hoist system and includes built-in fail-safe mechanisms.

Sel-Rex Reel-to-Reel Plater: For continuous and selective spot, stripe, strip, and controlled-depth plating of lead frames, continuous strip, ribbon, contacts, bandoliers, etc. Another custom engineered machine in modular form at "off-the-shelf" costs. Highest production for your investment dollar.

®Registered trademarks of Oxy Metal Industries Corporation



Blazing New Trails in Automatic, Large-Volume Electroplating of Base Metals

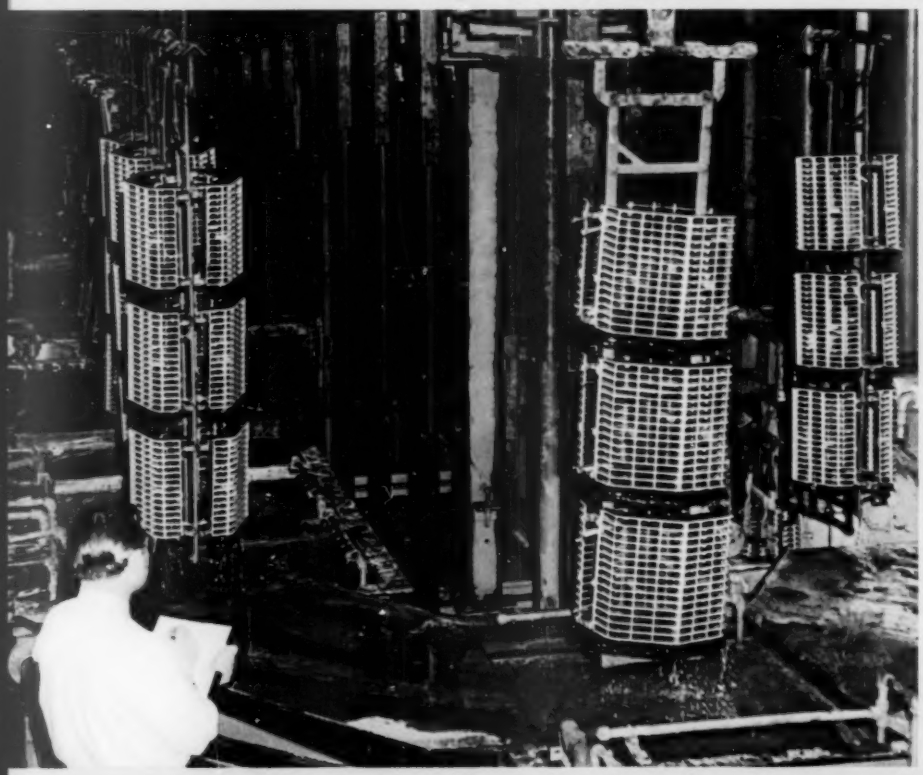
Almost single-handedly, Udylite® has updated and improved technology for the vast base-metal plating industry. Their expertise and long experience in the field has enabled OMIC's Equipment Systems Division to pioneer new ideas and concepts in automatic, high-volume, base metal electroplating, and other finishing operations. All Udylite return-type machines are preassembled and mechanically pretested.

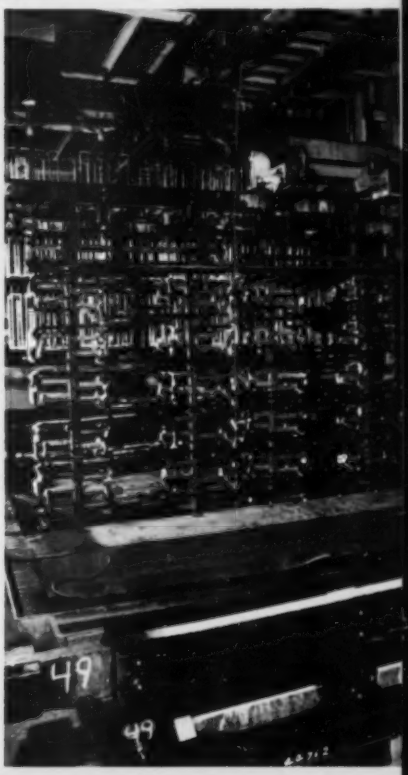
Udylite Cyclemaster® I, II, and III: Cyclemaster, the workhorse of the plating industry, has been redesigned to carry even larger, heavier, and more profitable loads. Cyclemaster II and III, new fully automatic machines, incorporate all the advantages of the original Cyclemaster, including low initial cost, dependability, simplicity of operation, machine and solution accessibility, and practically maintenance-free operation. Ideal for rack-type electroplating, cleaning, phosphating, chromating, and painting.

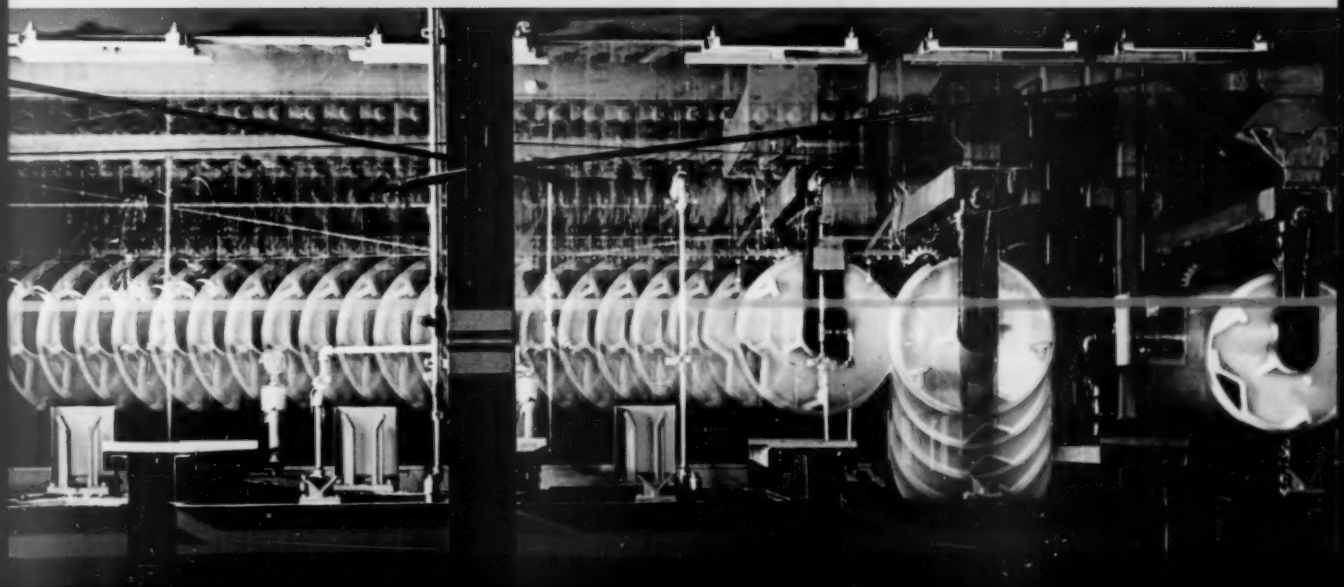
Udylite Senior Automatic: Pusher-type split-rail fully automatic plating and finishing line for high volume rack work. Senior Automatics feature compact design, and are available with many special operations to suit individual needs such as ROC Automatic Rack Loader and Unloader, SUF Loader, end and side non-lift sections, lateral skip, delay dip, and transverse transfer.

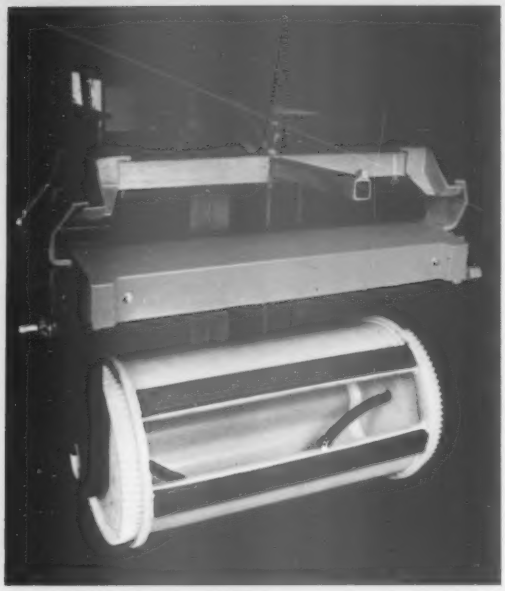
Udylite Side-Arm Automatic: Mechanically driven, chain-type automatic line with capacity up to 240 racks per hour, this machine is highly popular for any processing operation which requires multiple skip cycles. Another workhorse, generally used as a double-row unit for large racks.

Udylite Programat® Hoist System: Fully automated, modularized, for rack or barrel work, this unit is the most popular and sophisticated approach to heavy duty processing. Lines may be set up for single or multiple programming, and models available cover loads ranging from 700 up to 4000 pounds, dual speed.









Specially Designed Cylinders For Improved Bulk Finishing

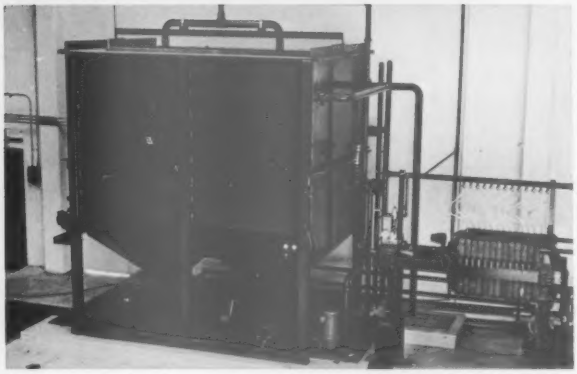
OMIC's advanced concepts for more profitable automatic finishing wouldn't be complete without a look at its unique barrels and cylinders for bulk finishing.

Udylite HOB® I: A revolutionary concept, the HOB I horizontal oscillating barrel eliminated the door and fasteners, making load/unload functions totally automated, while also providing for better current carrying capacity, and a substantial increase in overall production.

Udylite HOB II: Incorporates the advantages of the HOB I, including higher plating speeds and automatic load/unload, while being designed for use in normally corrosive acidic or alkaline solutions without appreciable loss in wear life. No metal parts in solutions. Increased production capacity in most applications.

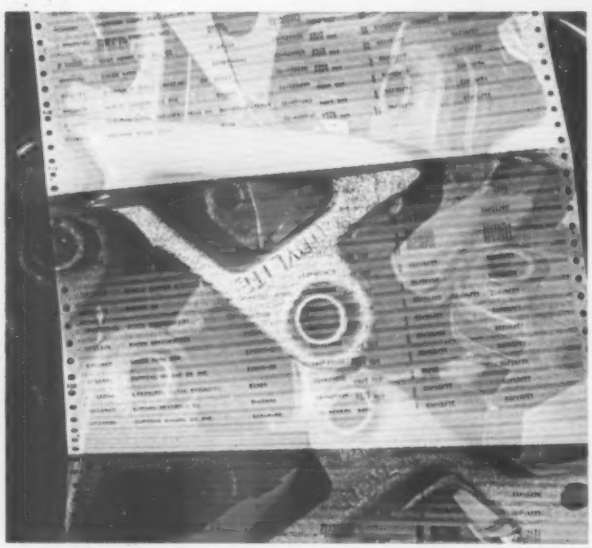
Udylite Udy-Pro®: Polypropylene barrels especially designed with heavy bussing (up to 1500 amps) to permit greatly increased plating speeds. Teflon bearing sleeves reduce friction, greatly extending efficient working life.

Udylite Oblique Cylinders: Specially designed for efficient tumbling, these new units provide better plate distribution and are available with economical button contacts and option or round or slotted perforations. The heat-formed bottom of these cylinders eliminates welding and provides for longer life . . . dramatically reduces solution drag-out. Can be ordered from many different materials of construction to suit individual needs.



Effluent Treatment and Recovery Systems

Through our extensive design and engineering services we are able to offer a program tailored to your individual needs. There are many, many ways we can help you meet pollution control regulations with minimum impact on your pocketbook . . . often even reducing your use of water and chemicals as well as effecting improvements in your product. We have earned our reputation as the first choice of metal and plastics finishers for an effluent control program.



Parts and Service

The Equipment Systems Division is dedicated to ensuring continuous production by owners of our machines. Professional field service coupled with fast delivery of spare parts is the OMIC sword you can depend on to cut away at lost production downtime. Our team of service personnel has a combined 150 years of metal finishing experience behind them. These highly-skilled problem solvers are constantly on call, 24 hours a day, 7 days a week from coast to coast to help solve any emergency that may affect your operation.

Backing them up is the computerized Parts Department. In emergency situations replacement parts can be on their way to you within hours—or, if necessary, hand carried by our servicemen for immediate installation. Stock parts are shipped within 72 hours anywhere in the World regardless of the model or age of your machine. Trained customer service representatives are on hand at our headquarters in Warren, Michigan to handle any questions about this critical area of your business. Our goal is to serve our customers and our continued success rests on our ability to maintain our long standing record of performance.

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OXY METAL INDUSTRIES CORPORATION

PT-278

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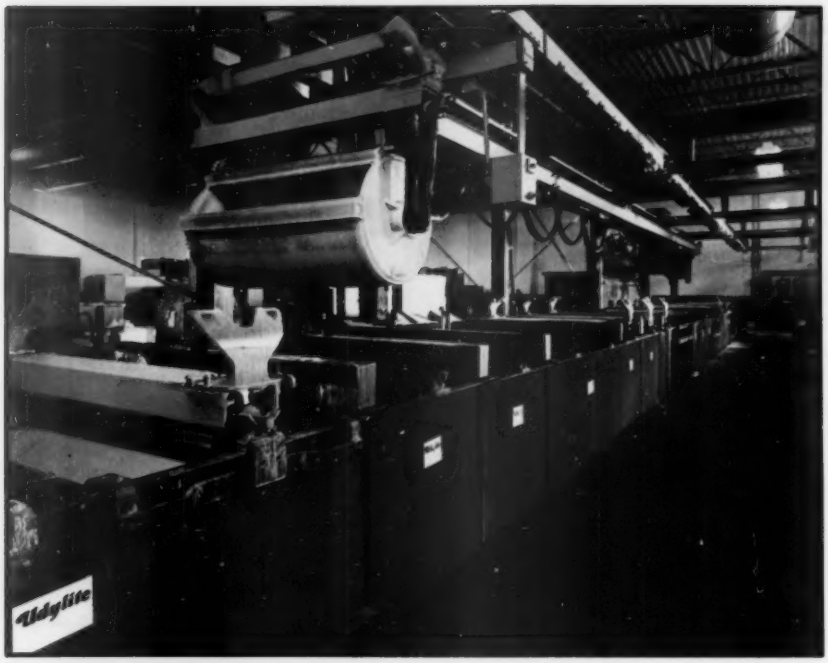


A large barrel plating system with integrated chemical cleaning stations in the background

Cleaning Up Chemical Cleaning

Various improvements are being utilized, and others researched to help the chemical cleaning process conform with regulations and lower costs

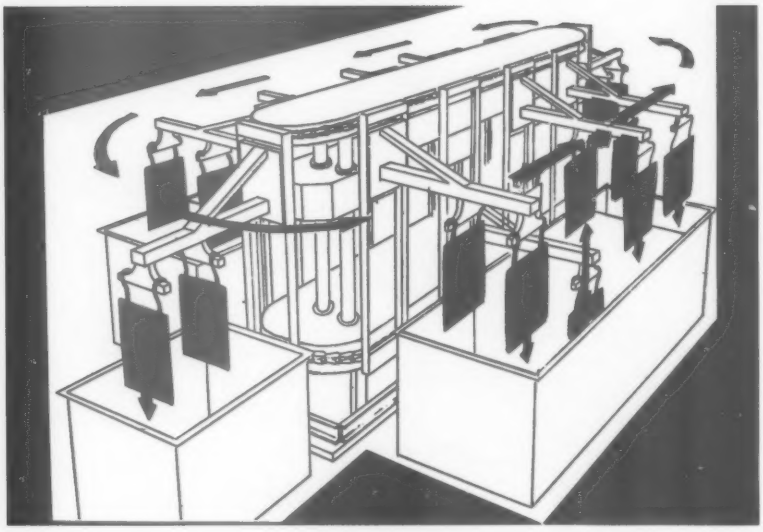
Numerous factors are contributing to the growing sophistication of the chemical cleaning process: labor cost has risen substantially, chemical and solvent prices have climbed about 400 percent since 1970, mandated safety and environmental regulations require tremendous capital investments, and consumerism continually demands higher quality.

But there's also good news: Most changes mandated by OSHA and EPA provide safety and environmental protection while contributing to improved operational efficiency and helping to control overall costs. Today, nearly all new chemical cleaning equipment is designed to conform with all current government regulations. And a wide variety of available optional features are being utilized to update existing facilities.

Chemical cleaning operations are an essential part of nearly every production operation. Generally, the need for cleaning is caused by the manufacturing processes. Among the most common applications are: preparation of castings, forgings, stampings, and so on for machining operations; removal of cutting chips and foreign materials between manufacturing operations; and removal of coolant or cutting oils to prevent contamination at a following operation. Chemical cleaning is also mandatory in preparation for painting, plating, and phosphate coating processes.

The majority of chemical cleaning operations are performed on steel, aluminum, brass, galvanized steel, and plastic materials. Consequently, a variety of cleaning solutions or solvents are used to remove various soils from the different materials. Normally, immersion or spray-type cleaning systems are used, and the equipment is specifically engineered and built to handle a particular part or family of parts.

The Improvements. Energy conservation and ecology considera-



This preliminary line drawing indicates the capability and flexibility of mechanized chemical cleaning equipment

tions demand significant improvements, and therefore challenge cleaning equipment builders and users. Worldwide shortages and rising costs necessitate drastic reductions in energy consumption. Mandated ecology regulations demand large-scale reductions of solvent emissions, and an economical procedure must be perfected to purify contaminated solutions and sludge prior to their disposal.

Some chemical developments already are helping to conserve energy. Typically, cleaning systems have consumed large amounts of energy to maintain liquids between 140 and 160 F in spray units, and 180 F and higher for immersion units. Recent developments have provided chemicals with comparable cleaning capability at 90 to 100 F. Still further improvements are expected from an industry-wide search for cleaning chemicals which are highly efficient at ambient temperatures.

Unfortunately, low temperature cleaning chemicals do not contribute to lower overall cleaning costs. The reduced thermo requirements effectively conserve energy, but reduced energy consumption is offset, and sometimes exceeded, by the increased chemical costs and longer cleaning cycles.

Waste treatment and disposal remains one of the main unsolved problems clouding the chemical cleaning process. Usually, every other sequence of a system is a clear water rinse. Inherently, though, cleaning chemicals hang on the production parts and holding racks to be carried over into rinse tanks. In addition to environmentally damaging chemicals, rinse tanks also accumulate a sludge consisting of various oils, grease, drawing compound, and metal particles. According to government regulations, the waste material must be made chemically inert before disposal; presently, this is an extremely costly process.

Waste treatment and disposal remains one of the main unsolved problems clouding the chemical cleaning process

In a move to alleviate the disposal problem, some chemical manufacturers have removed the phosphates from their products. The actual benefits, though, are highly questionable because most phosphate salts are insoluble and actually aid in removing minute soluble metal ions from the cleaning tanks.

Degreasing. Vapor degreasing, a widely used chemical cleaning process, offers the capability of providing clean, dry parts. Various solvents are available and used as the cleaning media. The vapor or liquid immersion or spray principle is used—the selection of the method being determined by the configuration of the parts to be cleaned. Degreasers normally are a tighly enclosed unit, and small standard type stand-alone versions cost about $700. But the majority of the production systems are specifically engineered and built for a family of parts; their costs range to more than $350.000.

A properly designed and maintained degreaser is a highly efficient cleaning system, and their use is increasing throughout industry. But since solvent costs have soared more than 400 percent since 1970, replacement of obsolete units or upgrading existing facilities is a justifiable investment.

OSHA and EPA mandates have had a costly effect on degreasing operations. On the other hand, the regulations are forcing the equipment builders and users to apply creative engineering in the design, operation, and maintenance of degreasers. In fact, a properly designed and operated degreaser will conform to all current OSHA and EPA regulations. More significantly, it provides the user efficient and economical operation while consuming a minimum of energy.

Among the notable features incorporated in new degreaser systems are vapor-tight enclosures, normally closed covers, higher free board, refrigerated free board chillers, carbon recovery units, and exhaust systems activated by sensors which detect emissions at the tank lip. Mechanical devices also are available to rotate or tilt baskets of parts in the vapor area to completely drain solvent from various recessed areas.

A loosely controlled and poorly maintained degreaser contributes to excessive solvent loss

Reducing Solvent Losses. Numerous steps are available to effectively reduce solvent losses from existing degreasers. Since a loosely controlled and poorly maintained degreaser operation is a major factor contributing to excessive solvent loss, bringing the operation under control, stopping leaks, and sound maintenance can reduce solvent consumption up to 50 percent.

Additional solvent loss areas include evaporation from a degreaser's top, drag-out on parts, spillage, clean-out losses, and so forth. The simple addition of a tight fitting cover, designed for normally closed operation, minimizes evaporation losses from a unit's top.

Solvent drag-out losses can be eliminated with the addition of a mechanical device to raise parts from the cleaning area. Minimum solvent is used when parts are removed from the cleaning area at a maximum of 11 ft a minute. At this rate, heated vapors evaporate liquid from the parts. In contrast, manual raising of parts from a degreaser is usually performed too rapidly. Consequently, excessive solvent clings to the parts contributing to harmful emissions in the work area.

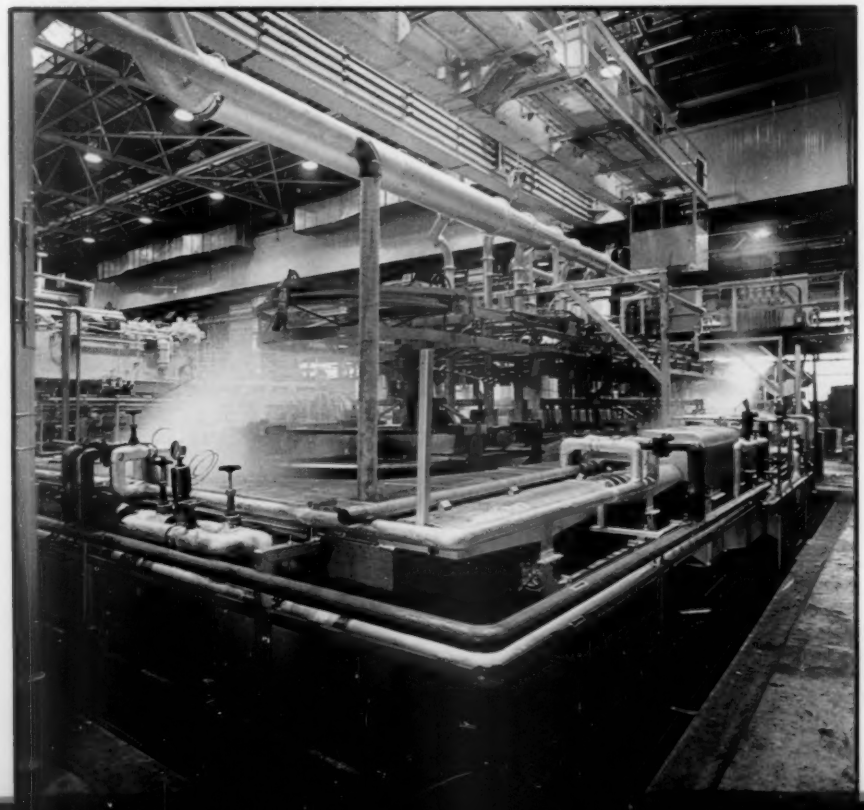
Adding a refrigerated free board chiller will contribute to a significant solvent saving and will minimize emissions. Vapors normally follow heat; therefore, a cold air blanket created by chiller coils keeps the vapors from rising, thereby reducing losses.

A recovery still slashes solvent loss during a system clean out. Whereas up to 50 percent solvent loss was considered normal during clean out, some stills are capable of recovering nearly 98 percent of the solvent. Although the solvent can be reclaimed numerous times, a small portion of stabilizer is usually required with each reclamation.

A point of caution relative to changing solvents: Degreaser manufacturers and the EPA do not recommend changing the types of solvents in an existing unit without a thorough investigation. The existing degreaser may not be capable of handling a different solvent; an alternate solvent may create serious mechanical or ozone depletion problems.

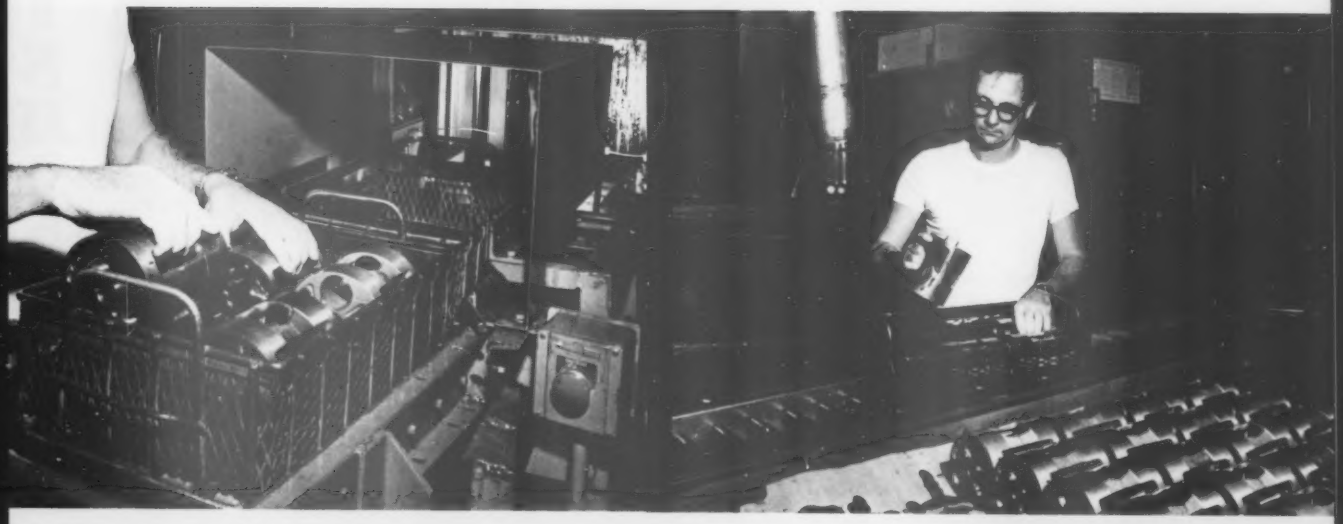
Proving It. An unusual Detrex Chemical Industries, Inc., degreaser system, engineered to

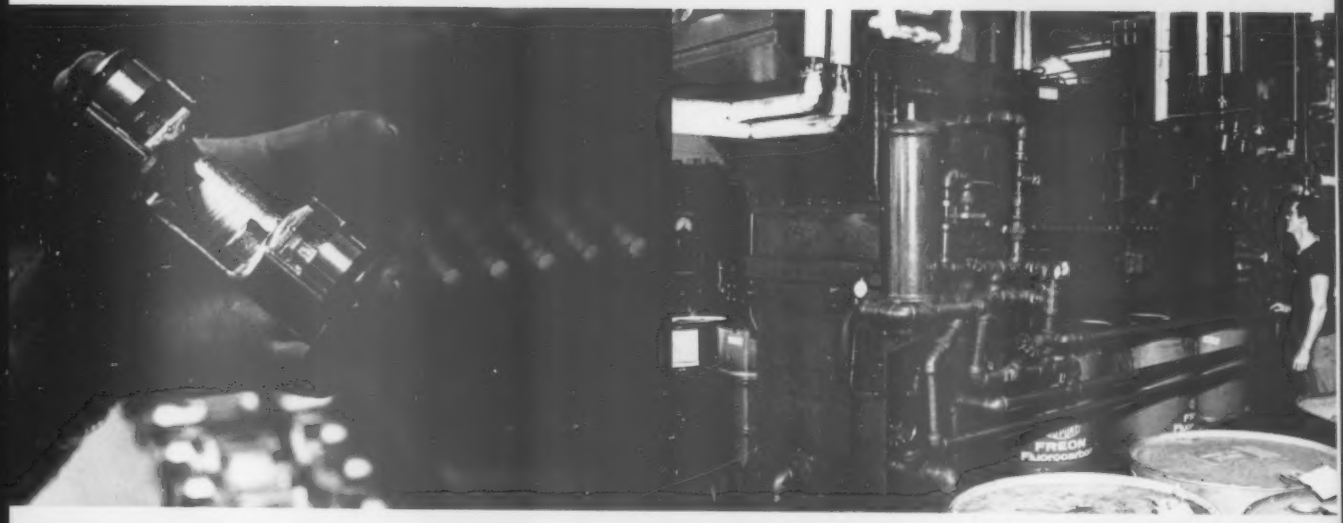
(continued on page 136)

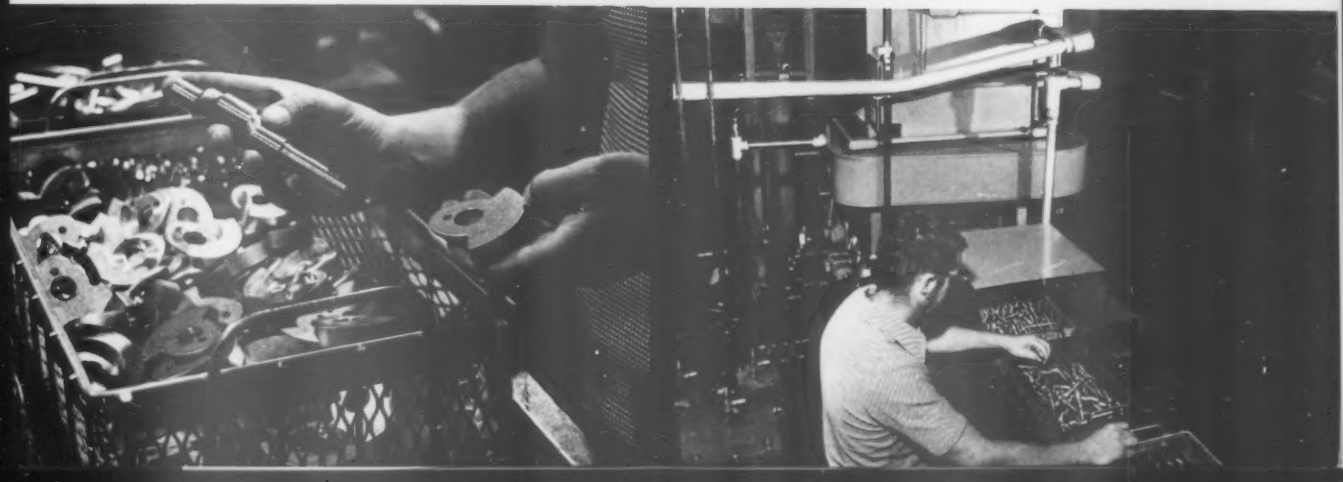


One of the more complex high production plating systems undergoing try-out in an automotive plant

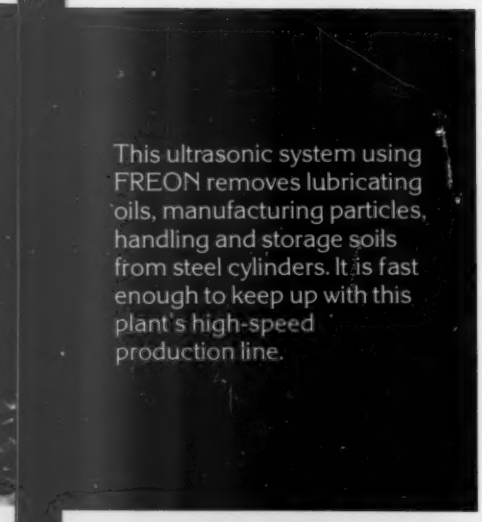
Metal cleaning with helps beat these



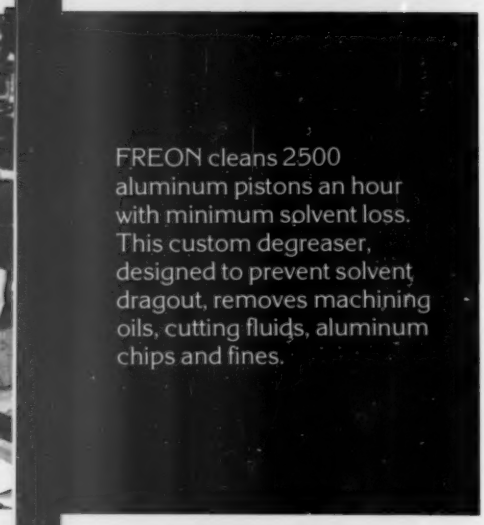




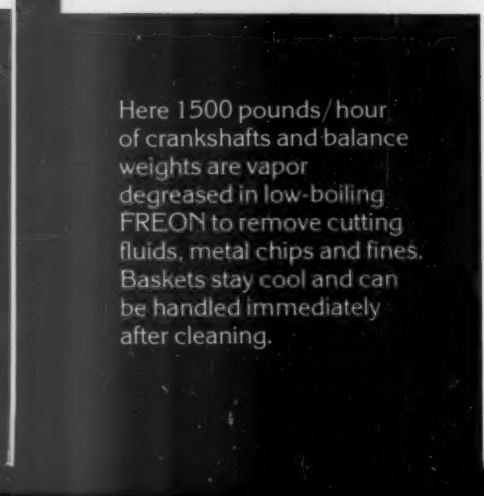
FREON* solvent production problems.



This ultrasonic system using FREON removes lubricating oils, manufacturing particles, handling and storage soils from steel cylinders. It is fast enough to keep up with this plant's high-speed production line.



FREON cleans 2500 aluminum pistons an hour with minimum solvent loss. This custom degreaser, designed to prevent solvent dragout, removes machining oils, cutting fluids, aluminum chips and fines.



Here 1500 pounds/hour of crankshafts and balance weights are vapor degreased in low-boiling FREON to remove cutting fluids, metal chips and fines. Baskets stay cool and can be handled immediately after cleaning.

Today, FREON solvent offers a wider range of systems for cleaning metal parts than ever before. Cleaning systems that can help you solve today's most important manufacturing problems:

Emission control. Closed loop cleaning machines and auxiliary equipment are built to recycle and reuse FREON solvent. This helps keep vapor emissions at acceptable levels and reduces disposal problems. While FREON solvents are exempt from vapor discharge limits in many areas, we believe that vapor recycling is the most economical and efficient approach to emission control.

Energy conservation. Low-boiling FREON solvent keeps vapor degreasing temperatures below 120°F. This saves process energy, eliminates parts-cooling, and can reduce air conditioning loads.

Employee safety. Since FREON solvent cleans at low temperatures, it's safer and more comfortable to work with than high-boiling solvents. Its vapors are nonflammable and of low order toxicity, resulting in a high OSHA Time Weighted Average (1000 ppm for FREON TF solvent).

Cost reduction. FREON solvent cuts costs by using less energy for cleaning and air conditioning and by efficient recovery and reuse of cleaning agent. What's more, output/yield may also increase because FREON cleans fast and eliminates waiting for parts to cool.

Ask a FREON Solvent Equipment Manufacturer about a cleaning system that will fill your specific requirements. And look to your local Authorized FREON Solvent Distributor to keep you supplied with FREON packed, sealed and guaranteed pure by Du Pont.

AUTHORIZED Du Pont FREON FLUOROCARBON CLEANING AGENTS DISTRIBUTOR

FREON SOLVENT EQUIPMENT MANUFACTURER

Find out more about FREON solvent now. For details on metal cleaning applications, send us the coupon below.

E. I. du Pont de Nemours & Co. (Inc.), Room 35644, Nemours Building, Wilmington, DE 19898

☐ Please send me details on FREON for metal cleaning.

What product are you cleaning?_____

How do you clean it now?_____

Name _____ Title _____

Company_____ Address _____

City_____ State _____ Zip_____

☐ Please have a Du Pont cleaning specialist call me. Phone_____

*Reg. U.S. Pat. & Tm. Off.

DU PONT

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CIRCLE NO. 43 ON READER INQUIRY CARD

(continued)

clean automotive carburetor housings, utilizes both the immersion and solvent spray principles. Reportedly, the unit provides a 90 percent cleaning improvement and consumes considerably less solvent, compared with the previous cleaning system. After proving the value of the system, the user installed six units in 1976 and added two more in 1977. Plans are now being completed to replace the rest of the old-style units in the near future.

In the manufacturing area, the combination immersion and spray degreaser system effectively cleans lapping compound and cutting oils, while removing cutting chips from numerous small holes in the complex carburetor housings. The system has the unusual capacity to spray solvent at 100 psi; normally a maximum of 8 psi is feasible under the conventional degreaser vapor blanket.

The high pressure solvent spraying takes place in a sealed chamber located between two solvent tanks. Parts are manually loaded in a clam-shell fixture constructed of wire rod which permits maximum exposure to the cleaning solution. The parts travel on a conveyor through the first immersion tank, into the spray chamber, through the second tank, and are discharged within an eight-second cycle.

Energy conservation and ecology considerations challenge cleaning equipment builders and users

Conversion Coating. Conversion coatings are a cleaning and coating process which permits the use of short cycles. Crystalline and non-crystalline coatings prevent degrading and corrosion of unfinished metals and contribute to superior paint adhesion and surface finish. Iron or zinc phosphate coatings are applied on steel, aluminum, and galvanized metals, and chromate conversion coatings are used primarily on aluminum and zinc materials.

Process controls play an important role in highly efficient and reliable conversion coating operations. For instance, a thin, hard, dense iron phosphate coating applied at the rate of 40 to 60 milligrams per sq ft permits maximum paint coverage from a minimum amount of material and gives a high-gloss surface finish. Whereas, the ideal zinc phosphate coating is applied at the rate of 150 to 200 milligrams per sq ft.

But for parts which will be stamped or formed, a thick, porous zinc phosphate coating affords a definite advantage. The coating provides a superior bond for drawing compounds which contributes to improved metal deformation by facilitating deeper draws and severe forming operations. *VAW* □

Useful Literature

Belt grinders and flat finishers are described in a literature package containing a number of individual technical bulletins available from Hammond Machinery Builders, Inc. *Circle 565.*

Automatic polishing and buffing is described in a package of technical bulletins each showing different applications. *Circle 566.*

Electrochemical grinding is described in a series of technical bulletins each presenting a different case history. *Circle 567.*

Cylindrical finishers preparing surfaces for paint and polishing and buffing are shown in a series of technical bulletins. *Circle 568.*

A styrene-acrylic latex vehicle for water-borne baking finishes and providing clear and pigmented high and low gloss

We can finish

Products, components, piece parts. Gunstocks, watch springs, auto bumpers, doorknobs. Metals, ceramics, plastics, woods. Functional or decorative applications. No matter what you make. No matter what you do to it. No matter what problems exist. Harper can provide the mechanical finishing system for it.

Why would any company in its right mind make a statement like this?

Actually, solving finishing problems is what we do. And we do it better than anyone else.

Harper considers your needs in terms of the total finishing system you use: heads, conveyors, compound systems, fixturing. All standard modules.

All combinable into exactly the individual system you need, so you can add to it easily as your needs change. And you can have it all at consistently favorable prices.

There are times, though, when standard just won't do. And that's where Harper shines. We can produce the system to do what's never been done before.

There was a time, for instance, when nobody could automatically deburr or radius the holes in watch frames. Now, they're Harperized—faster and more accurately—by a simple process nobody's yet been able to duplicate.

There was a time when no one could remove heavy stock from bearing balls in less then several days of constant loose abrasive tumbling. Now, it's done all over the industry in a few hours by a Harper system. And it can hold tolerances of ± .0001".

Harper systems are doing all sorts of things that have never been done before, from developing very high compressive stresses to increasing the efficiency of an entire finishing department. All standard, now, at standard prices, from Harper.

industrial finishes is presented in a 30-page booklet issued by Union Carbide Corp.
Circle 574.

An acrylic emulsion vehicle for strippable temporary protective coatings is described in a 6-page brochure.
Circle 575.

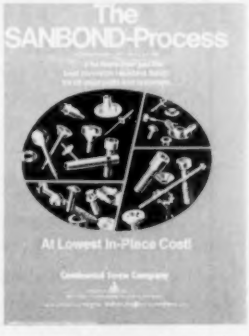
Design of electrochemical deburring tools, including fixtures and electrodes, is treated in a 32-page brochure by Chemform, Inc.
Circle 556.

Vibratory deburring and finishing mills, system accessories, and finishing media are described in a 12-page brochure available from Sweco, Inc.
Circle 557.

Temporary rust preventives, and their selection and use in industrial plant applications, are described in a 10-page pocket-size booklet offered by Shell Oil Co.
Circle 570.

An electroless preplate system is described, along with its merits and capabilities, in a 4-page brochure by Borg Warner Chemicals.
Circle 571.

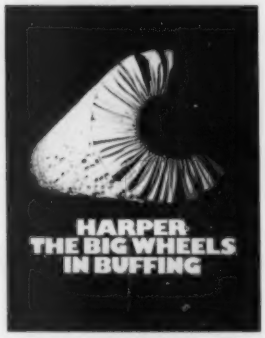
A dry, acid-free catalyst for plating printed circuit boards is described in an 8-page brochure.
Circle 572.



A corrosion-resistant finish for all steel parts and fasteners, consisting of a non-porous layer of high-purity nickel and a high lustre cadmium overplate, is described in a 4-page brochure available from Continental Screw Co.
Circle 580.

A calculator to help determine the number of parts which can be processed at one time in an existing vibratory finishing machine, and instructions on how to use it, are presented in an 8-page technical report by Roto-Finish Co.
Circle 561.

Cleaning of metal parts, including types of soils and typical cleaning operations are discussed in a 3-page technical report.
Circle 562.



Complete modular buffing systems, conveyor and spindle systems, polishing and buffing heads, and compound application systems, are described in a 6-page brochure offered by Harper Buffing Machine Co.
Circle 564.

Electrolytic deburring machines for removing burrs from hard-to-reach areas are described in a 4-page brochure by Fenn Manufacturing Co.
Circle 573.

Coated abrasive minerals that do the cutting, backings that support the minerals, and bonds which anchor and lock the min-

(continued)

whatever you start

A Good Question

What has Harper done for those of you who use wheels and belts instead of abrasive or vibratory tumbling? More than you think.

Instead of lots of expensive special heads, and lots of expensive fixtures, we're the ones who developed the idea of using a few very long, very standard low-speed buff wheels.

It's the Mush Buffer. Up to 12 feet of easily replaceable, economic buffing surface that performs every function in one single operation and turns work out 4 times faster than any other system you can use. There are no constant replacements of many odd-shaped heads.

There is no metal pullout due to high spindle R.P.M. There are no leave-off lines. And there's minimal downtime for wheel change. All controls are conveniently located at operator's station.

Better yet, the standard mush buffer concept can be tailored to any need. It's just another custom system from Harper. At another standard price.

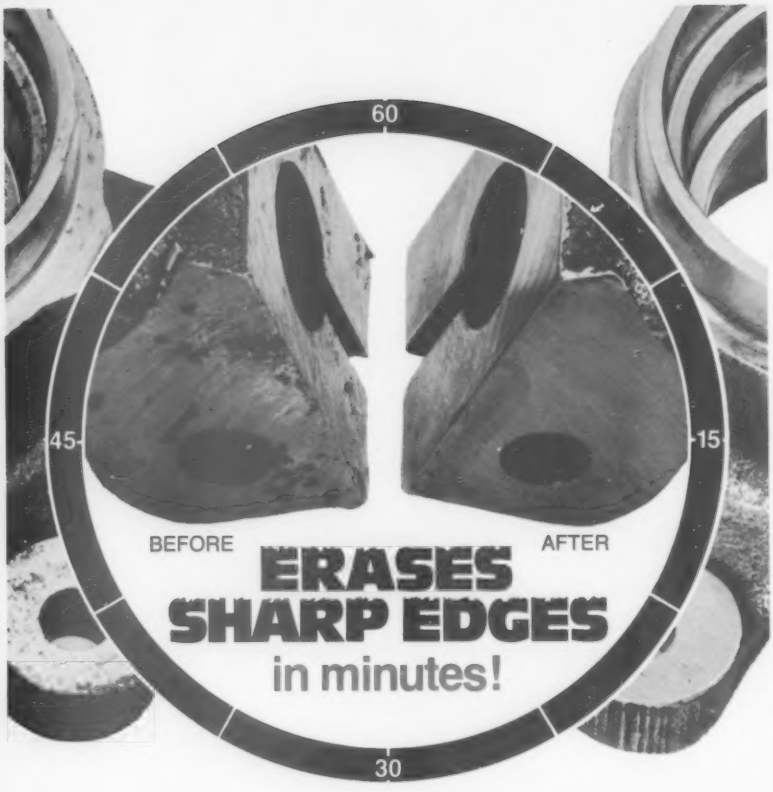
A Good Answer

Finding solutions to problems – speed, price, precision, application – that's Harper's job. In the past, not everyone has remembered that. And you should. Because Harper's toll-free finish line **1-800-243-5190** connects you to Harper's Tom Andrew.
For answers. For information.
For advice.

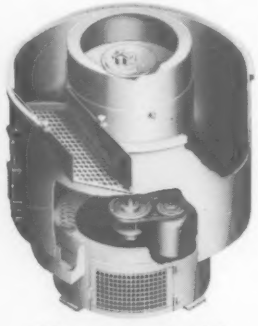
And because, when problems develop, Harper can find the answer before you lose your marbles. Maybe even before you make them.

THE HARPER BUFFING MACHINE CO.
363 Ellington Road, East Hartford, CT 06108

CIRCLE NO. 44 ON READER INQUIRY CARD



ERASES SHARP EDGES in minutes!



We can prove it!

Send us your sharp, dirty parts to be cleaned, one finished sample, and your production rate. Our laboratory analysis will provide recommendations at no cost.

Everyone knows the Roto-Finish parts washer cleans parts. But what you may not know is that it also erases sharp edges. Automatically processes small or large parts, continuous or batch. From sharp to smooth in minutes. That means safer, easier handling and assembly, inside and outside the plant.

The Roto-Finish parts washer requires no heating or venting units. Takes less floor space, is simple to install and maintain. Leaves parts lustrous and smooth. It's got an edge on other washers.

Roto-Finish®

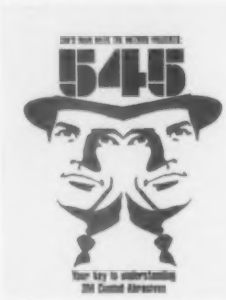
3702 Milham Road
Kalamazoo, Michigan 49003
Phone (616) 327-7071

Please send literature on Roto-Finish parts washer equipment.
Our parts to be cleaned are
(material, size, description)_____
Our production rate _____ Drying required, ☐ Yes ☐ No
☐ Have your parts washing specialists call for appointment
Name / Position _____
Company / Phone _____
Address / State / Zip _____

CIRCLE NO. 45 ON READER INQUIRY CARD

Useful Literature

(continued)

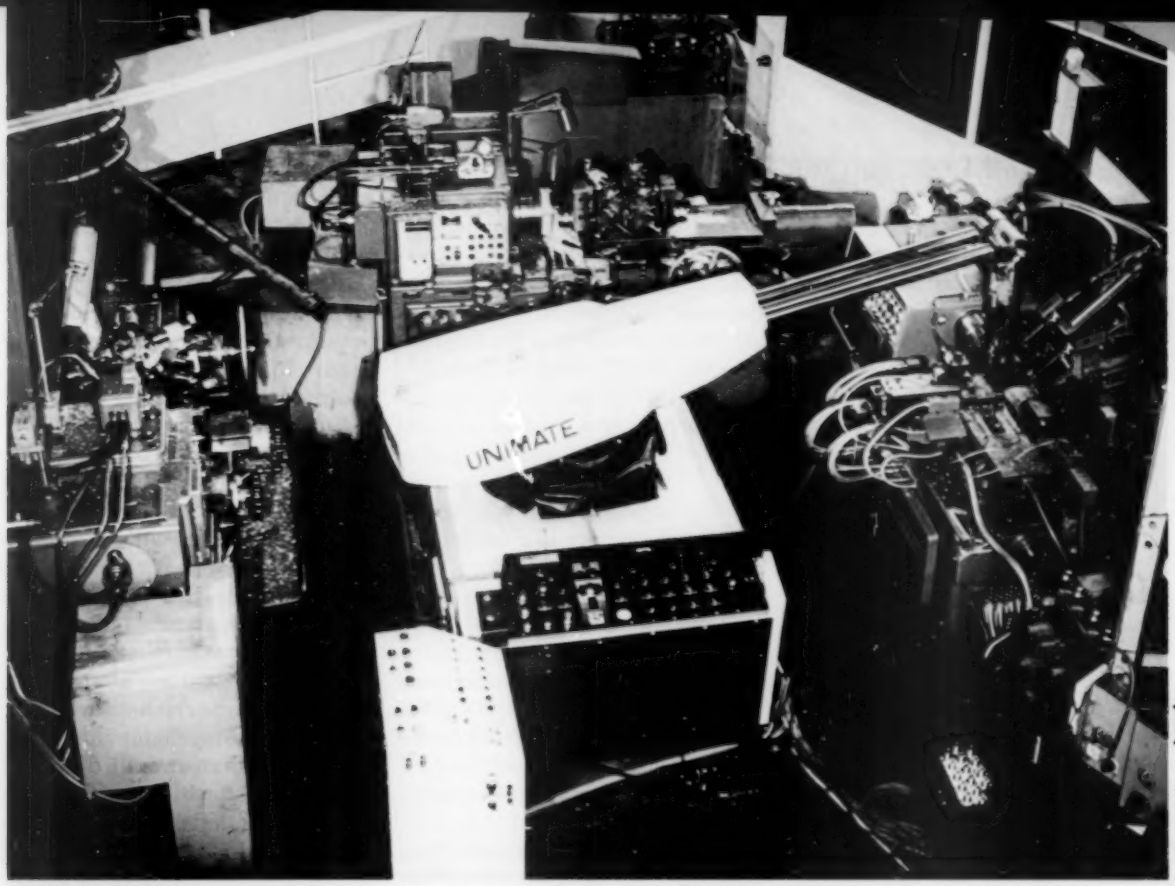


erals to the backing, are discussed in an 8-page brochure offered by 3M Co.
Circle 558.

Problem solving coating and finishing technology, application methods, engineering, and application methods, are discussed in a 26-page brochure by Linde Div. of Union Carbide.
Circle 559.

Inhibitors that reduce metal corrosion in acid pickling tanks are described in a 26-page brochure offered by Sherwin Williams Chemicals.
Circle 560.

An automatic spray painting robot with simplified spray sequence programming is described in a 6-page brochure offered by DeVilbiss Co.
Circle 579.



(Unimation Inc.)

Automated Machine Loading: Some Whys and Some Hows

Automatic loading and unloading can help lift the productivity of production equipment ranging from transfer machines to standard NC machines . . . from lathes to diecasting and forging machines. Here are some tips on where to consider it, on how it can pay, and on steps to include in your planning

Wherever you have a production machine that is "operator-paced" you have an opportunity for improvement. The improvement may come in the form of reduced direct labor costs—that's undoubtedly where you'll look first. But it could also be increased output from the machine, in better or more consistent quality of parts, reduced inventories of parts, or in improved capital equipment utilization.

The improvement could be achieved with a robot or some other programmable handling device which will load, position, and then unload and transfer workpieces. The June, 1977, publication of the Numerical Control Society reports: "Automatic factories of the future will utilize industrial robots working side by side with NC machine tools in fabrication operations . . ." It is already happening.

• At the Xerox Corp., Rochester, NY, three Unimate robots load and unload six machine tools, including a pair of Computer Numerically Controlled center-drive, double-ended lathes. To reduce process time, the two CNC lathes were designed to machine both ends of the shaft-like parts at the same time. To feed the parts to the lathes the robots must linearly insert the parts a distance of 11 in. with a .150 in. clearance between the shaft and the chuck. The robots do it in less than two seconds. Because each robot has two hands, they can handle simultaneously

finished and unfinished parts and minimize the load and unload cycle time.

• At Alcoa's Cleveland Forge plant two Prab robots man a mechanical forging press. The parts weigh from 35 to 45 lb, and temperatures range from 600 to 800 F. One robot loads the press, picking the parts up from a conveyor. The second robot, at the rear of the press, picks out the forged part and deposits it on another conveyor.

Craig A. Hoskins, senior mechanical engineer at the plant, recently told an audience at an SME conference: "As one might expect, manual peak production rates exceeded the best robot rates. However, the bottom line is the eight-hour shift or three-shift operation. With these criteria, robot installation generally exceeds manual operation. These two robots replaced two men in the press crew. The number of human problems which interferred with and cut production were reduced. Greater production resulted, and there were fewer personnel problems for the foreman. These two jobs were the worst jobs in the entire crew; their elimination helped generate hourly-worker support."

• Even fully automated transfer lines are candidates for robot loading. A Greenlee line at the Redford Township (MI) plant of GM's Detroit Diesel Allison Div. is fed connecting rods and caps by a robot. Productivity is 25 percent better than it was with manual loading. Equally important, the operator is now free to check and change tooling, watch automated gaging stations, and make necessary periodic adjustments.

• At Fujitsu Fanuc's plant in Tokyo, a robot mounted overhead loads and unloads eight DNC lathes. Spokesmen for the company estimate that 7 operators are doing the work that would require 50 in manual operations.

Additionally, robots are being used successfully for loading heat treating furnaces, diecasting and injection molding machines, and stamping presses. And George Munson Jr., marketing manager, Unimation Inc., Danbury, CT, says: "Our customers commonly report equipment utilization gains of 40 to 70 percent."

Why Use Them? Dale Hendrixson, sales manager-U.S., Industrial Robot Div., Cincinnati Milacron, lists these reasons for considering robot loading of production equipment:

1. Robot uptime is usually in the 95 to 99 percent range. Since most machines have more downtime than that, properly maintained robots will be operating if the machines are.

2. Although you may have to justify the robot for the one job you propose it for, remember that it can be reprogrammed for changes in the work. It can even be moved to a new location, reprogrammed, and put to work on an entirely different task, such as welding or drilling. Chances are, the robot will outlive the job you first assign it.

3. If a quality problem is caused by occasional bumping or dragging of the parts against the machine or a guard, that problem will disappear because the program will have the robot make identical paths each time.

4. A robot may be the ideal solution to a job in which operator safety or the environment (heat, vapors, humidity, etc.) make it undesirable for the operator.

5. On many tedious or monotonous jobs, operators tire, become less effective, less productive, and may be less cautious. From such jobs operators may be glad to be relieved by a machine.

As for labor savings, many users feel that if they can replace two men they can probably justify the robot. Thus, two men on one shift or one man on each of two shifts, if replaced by a robot, may represent a direct labor cost saving large enough to permit the robot to pay for itself.

Hendrixson says these are some of the dollar items to be considered: Initial cost of the robot plus accessories, an annual maintenance cost (if you have no exper-

Two Bullard Mult-Au-Matics are automatically loaded and unloaded at the Indianapolis, IN, plant of GM's Detroit Diesel Allison Div. The job continues to be successful after nearly four years, sometimes running 24 hours a day, seven days a week

ience to use in determining this cost, you can estimate it at 3.75 percent of the installed robot cost), annual tooling costs (chances are grippers will wear and need replacement), power consumption, floor space, and taxes and insurance.

What Do You Plan For? Unimation's Munson advises these considerations when planning for automatic loading with robots:

1. Today's robots require known orientation of parts. While a great deal of research is going into robot eyesight and part recognition, the manufacturing environment must provide the means to retain part orientation.

2. In most instances there must be a reasonable volume of parts handled. However, occasionally runs as short as a single shift can be more efficiently handled by the robot; a factor is the setup times of the machine tools involved.

3. The robot's inherent ability to work steadily over long periods of time usually mean higher equipment utilization. When several machine tools are grouped around a robot for successive loading and unloading, attention should be given to the individual machine tool cycle times in devising an operation to keep the robot active servicing the machine tools on demand or sequentially.

4. Traditionally, machine tools are set up (tooling, chuck travel, controls, etc.) with the superior intelligence of a human operator in mind. When using robots, a number of changes usually are required. For example, to relieve the need for extreme positioning and to improve reliability of the operation, chuck travels, generally speaking, should be about ¼ in.

5. In the planning stages, consider whether buffer storage systems should be created between machine tools. They can keep the process moving even though planned or unplanned downtime (such as tool change) occurs in certain sections.

6. In-process inspection techniques should be considered. Again, the robot and its control system can adapt and respond to automatic inspection information.

7. Ideally, it probably would be desirable to have a dual gripper capable of extracting a finished or machined part while holding a fresh part for immediate loading. Further, in your planning consider carefully the total weight of the part or parts and the robot tooling (hand or gripper) to assure smooth, untroubled operation.

8. It's a good idea, when possible, to provide for recourse to manual operation in the unlikely event of a major breakdown in the robot.

9. If the machine or machines being loaded and unloaded are metalcutting machines, chip blow-off and chip removal must be given close attention.

10. In many cases means must be devised to insure that parts have been properly clamped or chucked to prevent possible tool breakage and downtime.

The Acid Test. The economies and benefits of robots in machine loading and unloading are well-documented in scores of plants and applications. But authorities agree that if your studies show you won't get an adequate return, then don't buy. If the robot will produce additional parts you don't need, then you've gained nothing.

Robot loading is no panacea for production operations. But properly planned installations can and do pay off. *RFH* □

PRIME POINTS TO CONSIDER WHEN EVALUATING A ROBOT

1. Is there a robot which can perform the tasks which are essential?
2. Are emergency service and parts available for the robot selected?
3. Can the installation be made so that the system can be serviced and maintained conveniently?
4. Can the entire operation be kept safe?

SYSTEM LIMITATIONS

1. The robot will not make the associated machines do their individual operations any faster.
2. The robot will not improve the reliability of the associated machinery.
3. The robot cannot make random decisions.
4. Where several machines are serviced by one robot, the interdependence can be a problem.

Source: Walter E. Fritz, tool engineer, Detroit Diesel Allison Div., GM, from a speech given at an SME robot conference.

Useful Literature

Justification of automated storage and retrieval systems is described in a 12-page brochure available from Clark Handling Systems Div. It presents instructions, charts, and payback calculations for comparison with conventional warehouse systems. *Circle 780.*

An automated storage and retrieval system planning guide is presented in the form of a 12-page workbook with 11 categories of questions to be answered. *Circle 781.*

Engineered chain conveyor systems for transporting raw materials, components, and finished goods through manufacturing are described in a 20-page brochure available from Acco. *Circle 747.*

(continued on page 143)

Unimate robots puncture the myth that to profit from automation you must manufacture the same thing forever.

Many manufacturers find that they often get locked-in with conventional automated production lines. A product change or production increase means practically scrapping the existing system for a new one. And you don't need us to tell you how much that costs.

But we can tell you that Unimate industrial robots offer you the alternative to "hard automation." They give you all the efficiency and economy of true automation without setting in concrete your entire production process. And the cost is a lot less than hard automation. We call it the flexible transfer line.

Flexible transfer line?

It is simply a product or parts production system that uses a group of machine tools served by one or more Unimate industrial robots.

If you study the model, you will see that there are seven machine tools or operations handled by four Unimate robots. They pick up parts from incoming conveyor belts, load and unload machine tools, inspect the finished work, and transfer the parts to outgoing conveyor belts or storage bins. When a product or production rate change is required, the Unimate robots are quickly reprogrammed.

Because the whole flexible line is regulated by a solid state programmable controller, the only humans are the cost accountants who come by to admire it.

How it's working in the midwest

A leading engine producer installed two Unimation flexible transfer lines to manufacture cam boxes and two kinds of cam followers for diesel engines. The lines

consist of four Unimate robots which transfer parts through machine tools for milling, drilling, tapping and broaching, sampling inspection stations, a deburring station, and a washer. The systems also include an input storage silo with elevator, buffer storage pallets, and outgoing conveyors.

This manufacturer compared special purpose automation against a Unimation flexible transfer line. He concluded that a Unimation system was more economical and could be in operation much sooner than hard automation.

The least costly way to automate your conventional or NC machine tools is to use standard, general-purpose Unimate industrial robots. A complete system designed and supplied by Unimation Inc. will provide the flexibility you need for your production changes...and without the need for scrapping expensive equipment.

Send for our brochure

It contains the complete story of Unimate industrial robots—the machines that work for men who think.

Contact Unimation Inc., Shelter Rock Lane, Danbury CT 06810; (203) 744-1800.

Unimation Inc.®

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CIRCLE NO. 46 ON READER INQUIRY CARD

Useful Literature

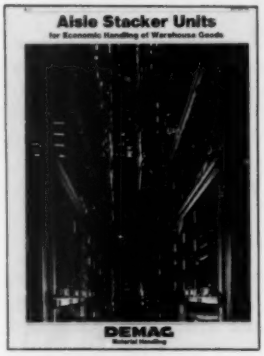
(continued)

High-rise, automatic storage and retrieval systems are described in an 18-page brochure.
Circle 748.

Louden crane and monorail systems and components for a wide range of applications are described in a 20-page brochure.
Circle 749.

Wright-way air and electric chain hoists are described in a 12-page brochure.
Circle 750.

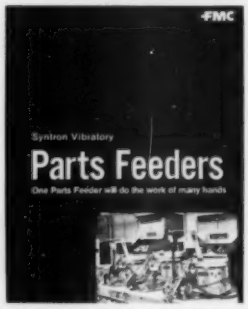
Vac-U-Lift automatic vacuum transfer systems are described in a 16-page brochure.
Circle 751.



Aisle stacker units and their electronic control system for economic handling of warehouse goods are presented in a 20-page brochure by Demag Material Handling Corp.
Circle 762.

A lifting device designed to reduce fatigue in such repetitive operations as loading heavy parts into and out of production machines is described in a 4-page brochure. It is electrically-operated and hand-controlled.
Circle 763.

Heavy-duty rigid wire mesh containers are presented in a 4-page brochure from Armco Steel Corp.
Circle 752.



Syntron vibratory parts feeders are described, along with illustrations of their applications in automatic processing and assembly machines, in a 44-page brochure offered by FMC Corp.
Circle 766.

Syntron rotary hopper parts feeders are illustrated in a 12-page brochure.
Circle 767.

Vibratory parts feeders with dual horizontal drive magnets are described in an 8-page brochure.
Circle 768.

Vibratory parts feeders with electrically adjustable vertical amplitude controls are presented in an 8-page brochure.
Circle 769.

Link-Belt oscillating conveyors for moving material along a trough are described in a 34-page brochure.
Circle 770.

Push-bar type chip handling systems are presented in a 24-page catalog by Kalamazoo Conveyor Co. A typical plant layout is shown.
Circle 771.

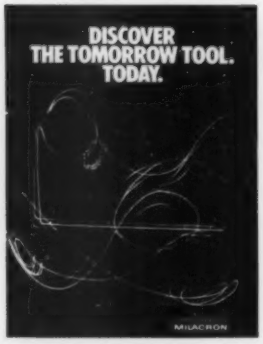
Steel strapping standards, seals, tools, and accessories for packaging various products are presented in a 16-page brochure by Interlake, Inc.
Circle 782.

Strap feed units, strapping heads, and basic strapping machines, are shown in a 16-page brochure.
Circle 783.

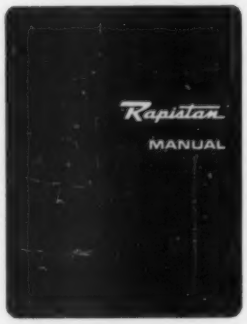
Stitching systems for corrugated and fibreboard containers are described in a 12-page brochure.
Circle 784.

A microcomputer controlled courier system for automatic storage and retrieval is described in a 6-page brochure.
Circle 785.

Modular conveyor components that combine to solve a wide variety of materials conveying problems are described in a 12-page brochure.
Circle 786.



An industrial robot with a built-in minicomputer control is described in an 8-page brochure available from Cincinnati Milacron.
Circle 787.



Gravity conveyor components, systems, and accessories are described in a 56-page brochure available from Rapistan Inc. A step-by-step procedure on how to select a conveyor is included.
Circle 774.

Overhead chain and trolley conveyors are shown in an 8-page brochure.
Circle 775.

Magnetic parts and scrap

(continued)

Useful Literature

(continued)

conveyors are presented in a 6-page brochure.
Circle 776.
Accumulation conveyors are shown and explained in a 4-page bulletin.
Circle 777.

Programmable industrial robots for general purpose use as well as tool handling are described in an 8-page brochure available from Unimation Inc.
Circle 745.

Vibratory Ideas, a 44-page booklet describing the design and application of a wide variety of feeders and conveyors, is available from Eriez Magnetics.
Circle 753.
Lifting magnets, and how to choose and use them, are described in a 12-page brochure.
Circle 754.
Use of lifting magnets in a wide variety of industrial uses is shown in a 12-page brochure.
Circle 755.
Its magnetic and vibratory test center and the services it offers in analyzing materials and suggesting ways to separate or move them is covered in an 8-page brochure.
Circle 756.

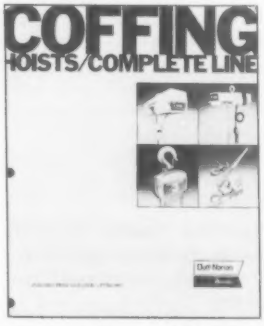
A two-directional belt conveyor with complete dispatching control from a central console is described in a 4-page brochure offered by Speedways Conveyors Inc.
Circle 778.
A portable parts conveyor for under press applications is described in a single-page bulletin.
Circle 779.

Automatic parts handlers with linear and rotary motions are shown and described in an 8-page brochure by Ferguson Machine Co.
Circle 746.

Cranes and monorails in three series for handling loads ranging from light (2 tons) through the majority range of 30,000 lb to the heavy load equipment

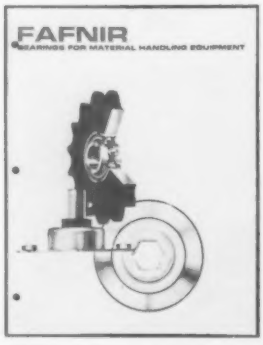
with capacity to 48,000 lb, is covered in a 12-page brochure by American Monorail.
Circle 764.

Conveyor equipment, and illustrations of portable and adjustable conveyors assembled from standardized components, are presented in an 8-page brochure by Mayfran, Inc.
Circle 765.



Worm drive hoists, electric wire rope hoists, link chain hoists, trolleys, and hoist accessories are presented in a 12-page brochure by Duff-Norton Co.
Circle 760.

Hydraulic jacks as well as mechanical and cable reel jacks, are shown in a 6-page brochure.
Circle 761.



Bearings and housed units for use in materials handling equipment are described in a 24-page catalog by Fafnir Bearing Co.
Circle 772.

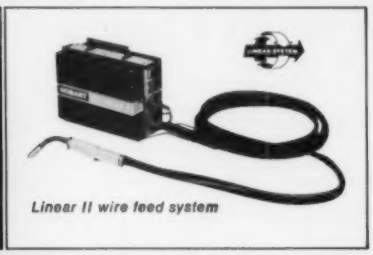
Battery-powered industrial trucks that comply with OSHA requirements are discussed in a 16-page brochure offered by Lead Industries Association, Inc.
Circle 773.

Index tables, electric, air, or hydraulically driven, and with accurate positive lock, are presented in a 20-page brochure by Jackson Machine Products.
Circle 757.
An index table selection and application reference guide contains 16-pages of engineering information, diagrams, and charts.
Circle 758.

HOBART

INNOVATORS IN ARC WELDING SYSTEMS . . . WORLDWIDE

Model 610-27-600



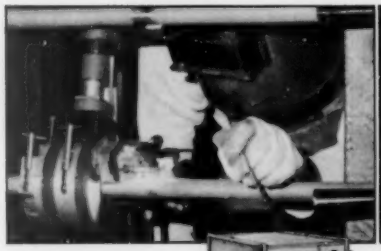
Linear II wire feed system

Semiautomatic and Fully Automatic
Feeds welding wire automatically up to 50% faster than electrode welding. Permits welding in all positions. No weld cleaning. Avoids costly electrode changing, stub end loss and large electrode inventories. There is a full line of wire feeders and guns—and motor generator and rectifier power sources—available.

Stick Electrode Welding
Power sources in a size and type to meet every welding requirement. DC Motor Generators, AC Transformers, DC Rectifiers and combinations of AC and DC. Also engine driven with and without auxiliary power for operating tools and lights.

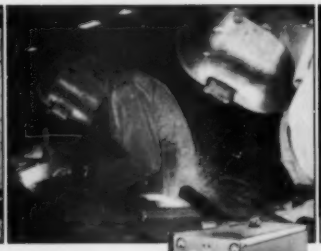
Models T-300, T-500

Linear II
Gain the cost saving advantages of long distance (50 ft.) semiautomatic welding. Use 15 lb. instead of 1 lb. spools of .035-3/64" aluminum wire or .035-.045 solid or tub. steel wire.



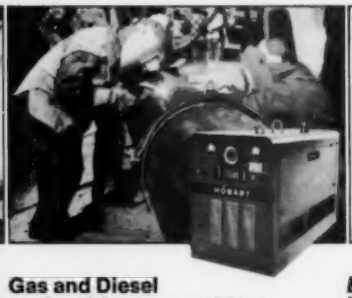
CT-300 AC/DC with series 100 programmer

Tig Welding
New Cyber-tig package for tungsten welding with interchangeable programmer drawers designed to meet 97% of Tig welding requirements.

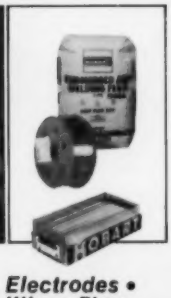


Models RMO-500, 750

Multiple Operator
Cut capital investment, reduce installation and maintenance costs where a number of stations are needed.

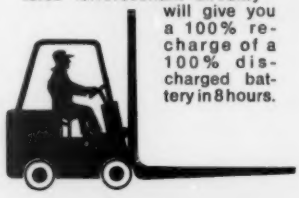


Gas and Diesel engine driven arc welders
A welder to cover every conceivable need for field use: air or watercooled, gas or diesel, DC or combination AC and DC weld current for stick or semiautomatic welding.



Electrodes • Wire • Flux
Hobart supplies a complete line of filer metals in types and sizes for every welding job.

Industrial Battery Chargers
Efficient, trouble-free economical. For heavy duty industrial truck batteries. Equipment features ferroresonant circuitry—will give you a 100% recharge of a 100% discharged battery in 8 hours.



Catalogs—Literature to help you improve efficiency

Arc Welding Systems
8 pages. Shows all Hobart welders and briefly describes.

Electrodes/Wire/Flux. 44 pages. Full details on all filler metals—plus charts.

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28 pages. Complete details on all accessories.

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152 pages. A must for anyone involved with welding. $1.00.

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For welding only. Plastic. 6" x 2¼". Only $1.00.

Procedure Analysis at the Hobart Technical Center
The facilities of one of the world's finest welding centers is available to you for problem analysis, procedure and process development, welding engineering assistance, training.

The heart of our capability is the spirit of cooperation Hobart people have to help you achieve your goals.

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CIRCLE NO. 47 ON READER INQUIRY CARD

To check the state of the art in fasteners and cold formed parts, contact Camcar.

Camcar has developed fasteners that are tamper-resistant, self-drilling, self-tapping, self-sealing and locking—even fasteners that automatically limit torque. We've tackled fastening problems on metal buildings, truck bodies, easy chairs, railroad cars and electrical assemblies. The results have been a steady stream of innovations (and patents) in problem-solving fastening systems.

Camcar has long been the leader in new ideas in custom fasteners—many of which are now industry standards—and cold formed specialty parts. It all stemmed from Camcar's first patent, the RAYCARL® cold forming process. This process permits the high-speed production of parts with toughness and precision not economically feasible by other methods.

Patented too, is the revolutionary TORX® Drive System that engages fast, torques positively and precisely and virtually eliminates the slippage, marring, head damage and tool wear associated with older systems. It's now being used in all major free world industrial nations.

When you send an inquiry to Camcar, you're enlisting the experience and ingenuity of people who take pride in providing the efficient solution to difficult fastening and parts design problems. And we can back it up with the capacity to deliver these problem solving parts by the millions.

When you need to know if a part can be cold formed—or a better way of fastening anything—write or call. We'll put you in touch with your local Camcar expert on shapes that fasten and save.

SHAPES that fasten and save

CAMCAR TEXTRON

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CIRCLE NO. 48 ON READER INQUIRY CARD

Trimming the Fat From Fastener Inventories

The average fastener user has the potential to carve over 30 percent from in-house fastener part numbers, asserts Dick Belford of the Industrial Fasteners Institute (IFI). Here are some tips for making your in-house fastener standardization program a success

Recent estimates show that U.S. manufacturers use nearly 2 million different types of mechanical fasteners. But now, on the eve of metric conversion, increasing numbers of fastener users are involved in efforts aimed at reducing the number of different fasteners specified for their products.

"For many fastener users," says Belford, "in-house fastener standardization can provide the means of dramatically reducing overall fastener expense. A properly planned and implemented program can reduce fastener inventories, cut procurement costs, reduce costly paperwork and related confusion, simplify material requirements, and set the stage for an organized transition into metrics."

Metrics to Aid In-house Simplification. Ford Motor Co., an enthusiastic proponent of internal fastener standardization, reports that over the past decade, millions of dollars have been saved as a result of an intense effort to reduce numbers of fastener parts. In 1967, Ford's North American Automotive Operations (NAAO) established a formal fastener standardization program which, over an eight year period, reduced inch-system mechanical fastener part numbers by a dramatic 38 percent.

FASTENER STANDARDIZATION... TIPS FOR A SUCCESSFUL PROGRAM

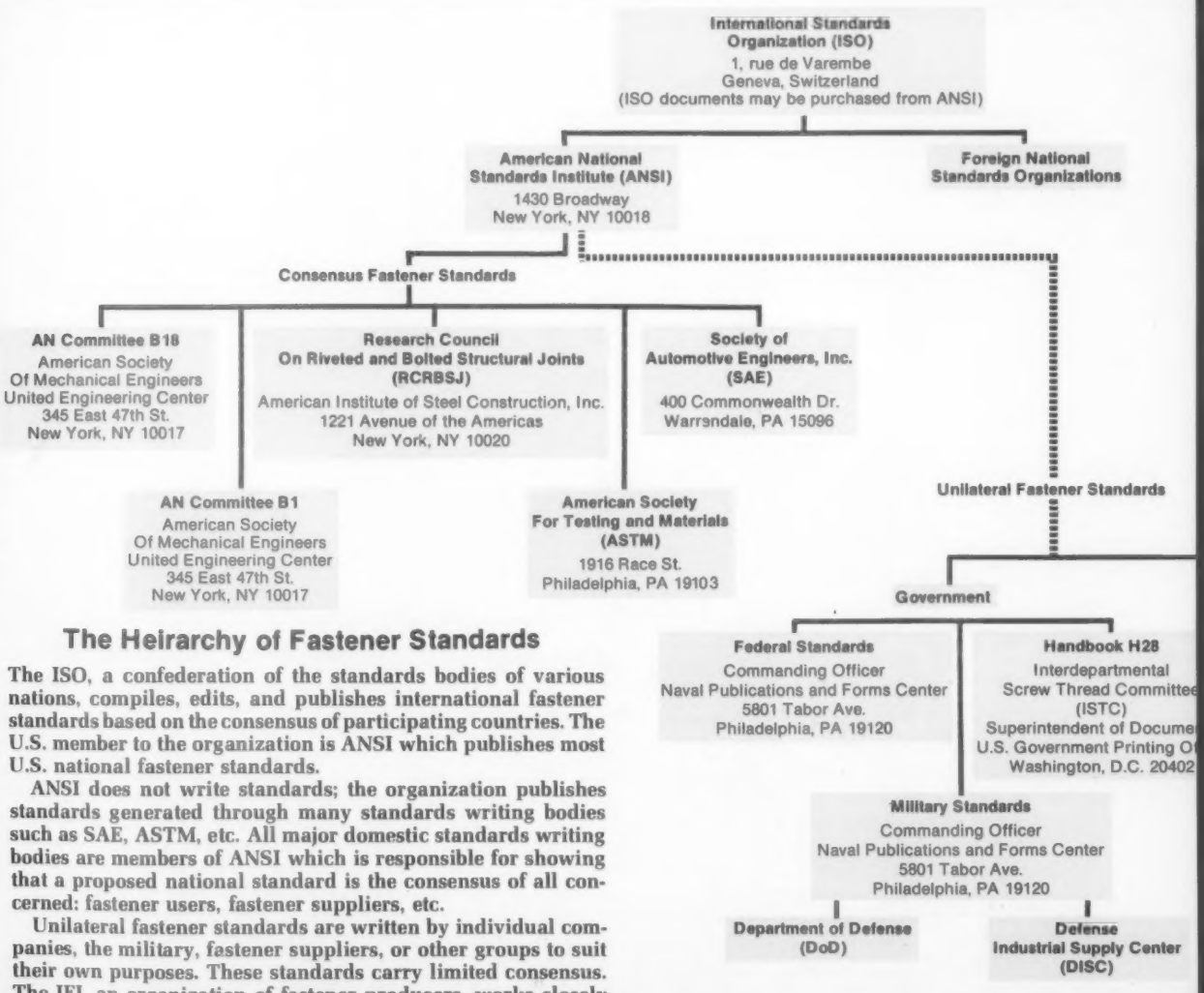
- Obtain the support of top-level management; clearly define management objectives and priorities to all involved
- Assign responsibility for program implementation to a single person or group
- Remember—standardization is not a clerical function. A successful standardization effort requires engineering, purchasing, and manufacturing input
- Develop the following standardization aids:
  - a) Part Number Classification List—a report showing all fasteners currently assigned internal part numbers broken down by fastener characteristics
  - b) Where-Used List—a report which shows on what part or subassembly each fastener is used
  - c) Material Nomenclature—develop a plantwide materials nomenclature which is easily understood and appropriately definitive
- Using both the fastener classification list and the where-used list and working with product design and purchasing departments, pinpoint specific fastener groups in which standardization will yield savings. Consider the following characteristics:
  - a) Fastener sizes
  - b) Fastener lengths
  - c) Strength grades
  - d) Head styles
  - e) Thread series
  - f) Materials
  - g) Platings
  - h) Coatings
- Investigate low volume fastener applications; switch to high volume fastener where possible
- Keep in close contact with fastener suppliers; most suppliers will be eager to participate in the program by offering technical assistance and direction
- Determine fastener availability from different sources
- Become familiar with the latest fastener standards, both inch and metric
- Avoid special fasteners where possible unless specific economic advantages can be shown. Review all existing special fastener applications and check in-place assembly costs
- Set up internal controls to ensure that new fastener part numbers are held to a minimum. Route all proposed new part numbers through the standardization committee, for example
- Provide product designers with an easily used fastener classification list. Designers are less likely to arbitrarily specify a new fastener part number if given easy access to a current part number list classified by fastener characteristics

Prior to the inception of the program, more than 11,000 different fasteners were used; by 1975, NAAO had reduced fastener part numbers to about 7500.

"We've shown here at Ford that component simplification improves product reliability," says S. E. Mallen, metrication planning manager. "An overproliferation of parts is confusing to designers and greatly complicates the problems of those responsible for part procurement and use.

"We're striving for continuous improvement in fastener standardization," adds Mallen. "However, metrication is temporarily complicating our efforts to simplify. But the problem would be more serious if we had not reduced inch-system fastener part number complexity before initiating the transition into metrics." Like Ford, some companies elect to combine current in-house inch-system fastener standardization programs with their metrication planning effort since the two are so closely related.

Most manufacturers see metric conversion as only a temporary obstacle to internal fastener standardization. They agree that in the long run, hard metric conversion will result in a significant reduction in fastener part numbers for most companies. The IFI metric fastener system features fewer standard sizes and fewer material property classes than does the inch-system or the traditional International Standards Organization (ISO) metric fastener system. For example, the IFI metric series fasteners consist of the 25 optimum sizes recommended by the ANSI/OMFS committee (American National Standards Institute/ Optimum Metric Fastener System). Ranging in size from 1.6 mm through 100 mm, the 25 metric fasteners compare to 34 standard sizes in the same size range for



The Heirarchy of Fastener Standards

The ISO, a confederation of the standards bodies of various nations, compiles, edits, and publishes international fastener standards based on the consensus of participating countries. The U.S. member to the organization is ANSI which publishes most U.S. national fastener standards.

ANSI does not write standards; the organization publishes standards generated through many standards writing bodies such as SAE, ASTM, etc. All major domestic standards writing bodies are members of ANSI which is responsible for showing that a proposed national standard is the consensus of all concerned: fastener users, fastener suppliers, etc.

Unilateral fastener standards are written by individual companies, the military, fastener suppliers, or other groups to suit their own purposes. These standards carry limited consensus. The IFI, an organization of fastener producers, works closely with ANSI and many of the standards writing bodies and often catalyzes standardization activity.

inch fasteners. Also, diameter/pitch combinations in metric have been reduced to 25, with just one standard thread series, compared with 57 combinations in inch fasteners having both coarse and fine threads.

John Deere & Co., for example, estimates that the change to standardized metric fasteners will result in a 50 to 70 percent reduction in fastener part numbers. The projected annual savings will run to millions of dollars, according to Deere.

Whether currently involved with in-house standardization or planning metric conversion, it's important for a manufacturer to be aware of current published fastener standards. Some manufacturers find it helpful to obtain revisions and new fastener standards on a continuing basis by subscribing, for a small fee, to up-date services offered by standards organizations.

At this time there are few formal national metric fastener standards in the U.S. However, the IFI metric fastener system parallels to a great degree proposed national metric fastener standards which are expected to be published by ANSI later this year.

Hard metric conversion will result in a significant reduction in fastener part numbers for most companies

Savings for the Average Manufacturer. Unlike the savings derived from some cost reduction projects which require large capital investment, the savings available through in-house standardization are not limited to large manufacturing organizations. Picker Corp., Highland Heights, OH, for example, a manufacturer employing about 2000, recently concluded a comprehensive two-year fastener standardization program which resulted in a 45 percent reduction in active fastener part numbers.

"We have been manufacturing X-ray equipment since 1933," says Ed Hoegler, standards engineer. "Like other well established companies, our fastener part numbers increased over the years as we introduced new products. About two years ago we began standardizing on certain fastener sizes, head styles, platings, and so on. As a result, we have reduced our active fastener part numbers from 1087 to the current inventory of only 595. We anticipate annual savings in procurement costs as well as difficult to quantify savings generated by reduced inventory complexity."

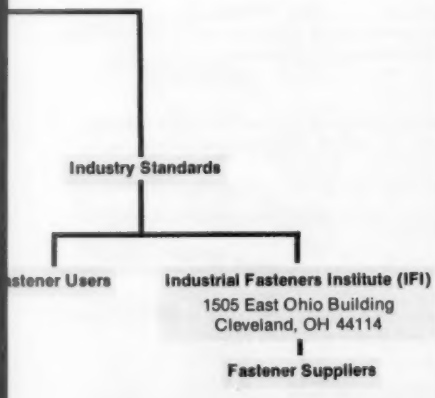
Success Through Plantwide Involvement. Like most cost reduction projects, in-house standardization is most effective in reducing costs when fully supported and actively directed by top-level management. Since the program involves nearly all departments either directly or indirectly, only well defined management objectives coupled with equally well defined and broadly communicated priorites will provide the momentum necessary to obtain the needed cost reductions.

Getting Started. Most manufacturers involved with internal standardization agree that the first step toward a successful program involves the assignment of responsibility. Dino Emanuelli, chief engineer for TRW's Greenfield Tap & Die Div., Greenfield, MA, explains: "The responsibility for program implementation should be assigned to a specific individual or group. In larger companies, a fastener standardization committee can be established; smaller companies may assign the responsibility to an individual, if necessary, on a part time basis.

"Standardization is not a clerical function. A successful standardization effort requires a well rounded input of engineering judgment, purchasing know-how, manufacturing knowledge, and a broad understanding of manufacturing cost relationships."
—Dino Emanuelli

"Standardization is not a clerical function. A successful standardization effort requires a well rounded input of engineering judgment, purchasing know-how, manufacturing knowledge, and a broad understanding of manufacturing cost relationships. Ultimately, the standardization effort will affect all departments: purchasing, manufacturing, product engineering, for example. So, the responsible person or group should be experienced in com-

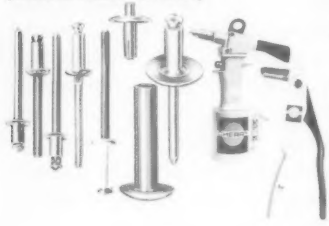
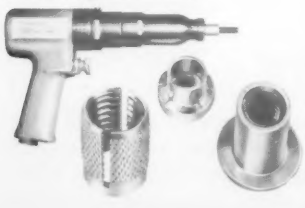
(continued on page 152)

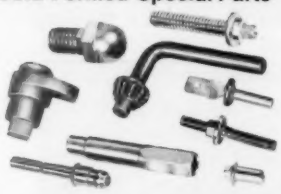


fastening ideas from Townsend

Over the past 160 years, Townsend has pioneered many innovative fastener ideas; matched fasteners to a tremendous range of applications; and solved just about every type of fastening problem, whether to defeat vibration, corrosion, metal incompatibility, twisting torque or metal fatigue. All designed to help reduce costs.

Shown is just a sampling of our broad line of standard and special fasteners and systems. Within our twelve manufacturing operations, we have the resources to produce a remarkable number of different fasteners for just about any application. For a more comprehensive look at Townsend and the many ways we can help you reduce fastening costs, write for new Capability Brochure to Townsend Division of Textron Inc., P.O. Box 370 H, Beaver Falls, Pennsylvania 15010. Phone: 412/843-6310.

PRODUCT	DESCRIPTION	APPLICATIONS
Commercial Blind Fastening Systems (includes installation tools) 	**Cherry C and N Rivets** Non-structural, pull-through and break mandrel blind rivets that conform to MIL and IFI standards.	Sheet metal work, name plates, toys, screens, etc.
	Cherry E, Q and *Cherry T® Rivets Structural, self-plugging blind rivets.	Appliances, automotive, metal furniture, boats, etc.
	Cherry D Rivets Structural, drive-pin blind rivets made to MS specifications and IFI standards.	Truck bodies, trailers, docks, containers, etc.
	Cherry-Mates® Two-piece fasteners with extra-wide grip capability.	Signs, stadium seats, bulk heads, sandwich type applications, long grips, etc.
	Snapo Break mandrel blind rivets.	Automotive aftermarket (body shops, garages, etc.)
	*Licensed under Townsend Patent No. 3,232,162 and Huck Patent No. 3,204,517.	
Commercial Lockbolt Fastening Systems (includes installation tools)	**Lockbolts** Lockbolts offer high strength and clamp-up, positive visual inspection. Diameter range—3/16" to 1". Total system includes strong, lightweight low profile electric/hydraulic installation tools—plus electric/hydraulic power pump system with two 3-horsepower pumps connected in tandem.	Across industry—railroad, automotive, heating and air conditioning, farm, furniture, appliances, conveyors, recreation equipment, heavy machinery, construction of all kinds.
Tubular and Solid Rivet Fastening Systems (includes setting machines)	**Tubular Rivets & Machines** Complete line of cold-formed tubular and split rivets in standard or special styles. Automatic setting machines with air, hydraulic, electric or manual power. Single, double or multi-heads.	General assembly fastening, and where fracture-prone materials are involved.
	Small & Large Solid Rivets Standard small rivets (3/32" to 7/16" dia.) available in 5 head styles—button, flat, truss, countersunk, and pan. Standard large rivets (1/2" to 7/8" dia. available in round, button, flat and countersunk heads. Various metals and finishes. Special solid rivets in all diameters and raw materials.	Assembly of parts in many industries including food, automotive, ordnance, aerospace, appliances, etc. Complete line of rivet setting machines. Custom designed for special applications in all industries.
Internally Tapped Fastener Systems (includes installation tools) 	**Perma-Nuts®** Combines a rivet and a nut. Roll or contained clinch. For automatic feeding and setting in high-speed riveting machines. High torque-resistant, permanently threaded fittings. Many styles, materials.	Used as nut plate, combination of nut and fastener, nut and bushing, nut and spacer.
	Perma-Pulls® Combines a blind rivet and a nut. Set by portable power or manual hand tools. Flat or countersunk heads.	Used as blind nuts, flush blind nuts, rivets and spacers. Replaces standard nuts, weld nuts and anchor nuts. Ideal for bulky products difficult to rivet on stationary machines.
	Post Molding Inserts and Tapped Holes Banc-Loks provide self-locking metal threads in plastic components after molding. Tapped holes provide strong threads in thin sheet metal.	Used in automotive, appliances, electronics, instruments, metal windows and doors.

PRODUCT	DESCRIPTION	APPLICATIONS
Cold-Formed Special Parts 	**Cold-Headed Parts** Cold-heading is a process for cold-forming simple and complex parts with greater speed and material economy than machining, especially for large quantity production. Progressive dies automatically shape wire or rod up to ⅞" dia. to predetermined profiles within acceptable tolerances. Secondary operations can include thread rolling, drilling, tapping. The process offers opportunities to combine two or more components into one to reduce cost, assembly time and inventory.	The possible applications for cold-formed parts are almost limitless over a broad range of industries, either as basic components or in assembly operations. They are widely used in household appliances, controls, transportation, boat manufacturing, motors, electronic equipment, and many others. Maximum benefits of cold-headed parts are realized when potential of the process is a factor in equipment design considerations.
Large Cold-Formed Special Parts	**Cold-Headed Parts** Material size capabilities from under ½" to over 1⅝" and automatic progressive forming with up to five dies combine to offer flexibility in special part production. Material types include steel, alloy steel, stainless steel, aluminum, etc.	Tool bit blanks for mining and construction, special upset and/or extruded parts for automotive applications, shafts and gear blanks for farm implement and other industries, extruded bodies and casings for munitions applications.
Auto Steering/ Suspension Studs	**Cold-Headed Parts** Close-tolerance, cold-formed studs, from carbon or alloy steels in short run or high volume quantities. Body sizes range from approximately ½" to over 1⅝". Progressive Headers, supported by a wide range of secondary forming and finishing operations, provide product flexibility.	Cars, trucks, tractors, heavy off-highway equipment, recreational vehicles and special applications such as linkages, connectors, etc.
Fabco Fastening Systems (includes installation tools)	**Topseal® Self-tapping Fasteners** H-3™ stainless and carbon steel sheet metal screws with attached metal-backed washers.	Weather-sealed attachment of metallic, plastic and asbestos siding and roofing sheets to wood and steel framing. Also sheet-to-sheet fastening.
	Topseal® Self-drilling Fasteners 410 stainless and carbon steel self-drilling screws with attached metal-backed sealing washers.	Rapid, weather-sealed attachment of roofing and siding sheets to framing members of pre-engineered metal buildings. Also sheet-to-sheet fastening.
	Weath-R-Seal® Washers Metal-bonded-to-sealant washers.	For gas, liquid and vapor-tight seals in a wide variety of construction and industrial applications. Seals from 2 psf to 40 psi. Fit #6 screws to ¾" bolts. Many metal and sealant combinations to custom-engineer applications.
	COLORFIXX™ Fasteners Molded nylon head on steel self-drilling or self-tapping screw body.	Decorative color through-molded to resist socket abrasion, won't scratch mating surface, won't rust, corrode or stain. Ideal for areas exposed to weather or corrosive atmosphere.
	Bi-Metal SAC® Fasteners Fasteners with corrosion-resisting stainless steel or Incoloy 825 head inertially-welded to a hardened carbon steel self-drilling or self-tapping shank.	Economical solution to fastening roofing and siding sheet for long service in highly corrosive atmospheres. For environments requiring unusual corrosion resistance plus strength of carbon steel.
Aerospace Fastening Systems (includes installation tools)	**Cherrylock®** Precision quality blind rivets produced to NAS specifications. Also MS blind rivets.	Attaching skins to structures in airframe, space and rapid transit vehicles. Attaching nut-plates.
	CherryBUCK™ New bimetallic fastener in which a high strength shank is joined by inertia welding to a ductile tail to provide an easily installed one-piece structural fastener.	Structural joining in high fatigue areas of wings and fuselages. Repair of honey-comb. Attaching skirts to surface effect vehicles.
	CherryMAX™ Unique blind rivet system featuring a driving anvil integral with every rivet assembly, locking collar assembled to the stem, and bulbed blind head for extra large bearing surface.	Install all diameters, all materials and all head styles with a single, non-shifting tool.
	Lockbolts High strength, high clamp-up, two-piece fasteners to replace bolts and nuts. Made to NAS specifications.	Structural applications in airframe assembly where removability is not necessary or desirable.
	Hex & 12 Point Locknuts Self-locking nuts having a prevailing torque locking action that holds the nut in position even under vibration and other conditions of dynamic loading.	Structural applications, shear and tensile, throughout the airframe. For use in critical strength, temperature and vibration areas, such as in jet engines.
	Nut-Plates Captive locknuts in various configurations, sizes and materials. Made to MS and NAS specifications.	A locknut attached, by riveting or welding, to thin sheet metal to provide a means of attaching removable access or inspection plates, accessories, etc.

TOWNSEND TEXTRON

CIRCLE NO. 49 ON READER INQUIRY CARD

(continued)

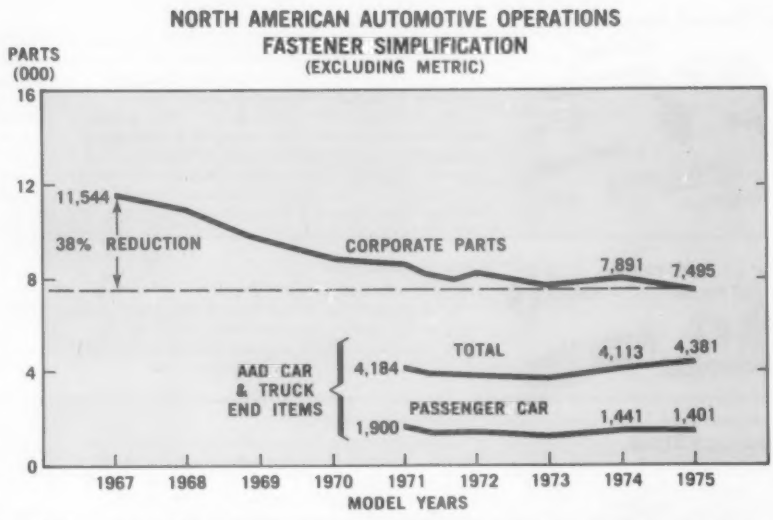
municating effectively with all departments."

Throughout the course of the standardization program, the standards engineer or committee should be in constant contact with fastener suppliers. Fastener availability is of particular importance. Not every "standard" fastener is always immediately obtainable in quantity from every supplier. Most fastener suppliers are eager to participate in such programs by offering technical assistance and direction.

Part Number Classification. An important step in the evolution of a fastener standardization program involves the classification of all fasteners currently assigned internal part numbers. Some manufacturers may be able to get this information through previously structured data processing output formats. Smaller manufacturers, who may not have computerized part number listings or manufacturers who have not previously classified fastener part numbers, may have to develop the list manually. In any case, a list should be made which shows all fastener part nmbers and descriptions classified by fastener type. For example, all hex head cap screws should be listed together, all socket head cap screws should be listed together, and so on.

The classification listing is important because each subgroup offers a starting point for standardization effort. Interestingly, many manufacturers report that this phase of the project often produces significant savings. The research and verification effort required to produce the classified part number listing often will reveal part number duplications and incorrect fastener descriptions.

The "Where-Used List." The next step requires the development of a "where-used list"—a report which shows on what part or subassembly each fastener is used. Again, many manufacturers have this information stored in existing data processing files; other manufacturers may have to compile the list manually using parts lists and bill of material documents.



Ford Motor Co. reduced inch-system fastener part numbers by 38 percent in an eight year period beginning in 1967. Ford reports that its internal fastener standardization program has saved millions of dollars annually by reducing procurement expense, inventory maintenance expense, and overall in-place fastener costs

The Importance of Material Nomenclature. Some manufacturers involved with standardization, especially those who use large numbers of special fasteners, are investigating the overall effectiveness of their internal material nomenclature systems. "There are numerous advantages to the development and maintenance of a consistent, accurate, and reliable material nomenclature," says H. Koerv of Bendix Corp. at the Annual Conference of the American Production & Inventory Control Society held recently in Cleveland. Koerv suggests that a properly organized and implemented nomenclature system offers the following advantages:

- Elimination of duplicate part numbers
- Reduction in transcription errors
- Ease of information retrieval by part number or by other numeric or non-numeric descriptors
- Ease of preparing special reports by combining characteristics or historical factors relating to material or components
- Ease of substituting material or components by retrieving information according to key characteristics
- Improved communications throughout the organization because everyone involved with material will be using the same terminology
- Less effort will be involved in carrying out material standardization and value analysis programs

To a large extent, the success of a standardization effort depends upon team work and the ability of interfacing departments to react quickly, accurately, and objectively when asked to evaluate proposed standardization alternatives

Formulating Alternatives. Using both the fastener classification list and the where-used list, and working closely with product designers and the purchasing department, the engineer should pinpoint the specific fastener groups in which

standardization would yield the greatest savings. Some manufacturers have found, for example, that it is sometimes more economical in the long run to specify "across the board" a single high strength-grade fastener instead of specifying two or three different strength-grades, each for a specific application. Savings in procurement and inventory costs may, in some cases, outweigh the added cost of using the more expensive high-strength fasteners for low-strength applications. Also, if only high-strength fasteners are stocked in inventory, the possibility of placing a low-strength fastener in a high-strength application is eliminated—a step toward reduced warranty costs.

Other fastener characteristics which should be reviewed by the standards engineer for possible standardization include fastener sizes, head styles, thread series, materials, platings, and coatings. A careful examination of internal requirements will usually uncover areas in which simplification will yield savings. For example, one manufacturer recently told PRODUCTION that the company had reduced its set screw inventory by 80 percent merely by recognizing that only one point style was required for their applications. Formerly, five different point styles for each size set screw had been specified.

When searching for areas where standardization will effect a savings, the engineer should consider low usage as well as large volume fastener applications. In some cases, a fastener used only on low volume parts or subassemblies can be replaced by a high usage fastener, eliminating the need to stock the slow moving fastener.

Standard Fastener vs. Specials. Generally, most manufacturers agree that the specification of special fasteners should be avoided since specials often are higher in cost and less quickly obtained. All special fastener applications currently specified should be reviewed to document actual in-place assembly cost. In some cases, the specification of a special or a modified standard fastener can yield significant savings. Most fastener suppliers can help determine which approach is most economical for a particular application.

Interdepartmental Cooperation. In some cases, it may be difficult to standardize. Minor design changes on some parts or subassemblies may be required in order to effect a particular standardization, for example. So, for this and other reasons, the success of a standardization program depends to a great degree upon team work and the ability of interfacing departments to react objectively, accurately, and quickly when asked to evaluate proposed standardization alternatives.

Although most standardization proposals will originate in the fastener standardization committee, input from many departments is required before a standardization can be effected. For example, the product engineering department will be asked to review proposed fastener substitutions and/or part design changes. They will have to determine the effects of the proposed changes on product cost, performance, appearance, or safety.

And the standards engineer may call upon the purchasing and cost estimating departments to help show how the proposed standardization will affect procurement costs. Other departments will be asked to help as the standards engineer develops the documentation showing potential savings generated through inventory maintenance cost reductions, reduced floor space requirements, assembly time savings, and so on.

Setting Up Internal Controls. Probably one of the most important phases of a successful standardization program involves the establishment of internal controls which help ensure that in the future only necessary fastener part numbers are assigned to the system. Such controls can be set up in various ways. A common approach merely requires that every proposed fastener part use and new fastener part number be approved by the standardization committee. In this way, the standardization committee is given the opportunity to suggest standardization alternatives before a part is produced.

Holding the line against fastener proliferation requires discipline in product design. Many of the larger manufacturers have shown that product designers are less likely to arbitrarily specify a new fastener part number if the designers have easy access to up to date, comprehensive part number listings according to fastener characteristics. *TJD* □

How Well Do You Manage "External Influences"? "More and more today, it's becoming apparent that some top-level executives in the U.S. lack experience in dealing with external pressures such as material shortages, rising material costs, and transportation problems, for example," says George Kuper, executive director of the National Center for Productivity and Quality of Working Life, Washington, D.C.

"To a large extent, cost reduction activity in most companies has traditionally focused on internal objectives such as labor reduction or increased labor utilization. However, in the U.S. over the past few years, some material costs have risen three times faster than average labor costs. As a result, the profits of many companies are sagging under the load, reflecting the need for executives and managers to sharpen their skills in dealing with external influences. Certainly, those managers who recognize this critical need to develop aggressive management techniques for dealing with 'outside' pressures will be the managers who lead their organizations to higher profits in the years to come."

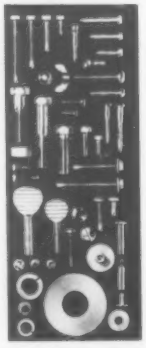
Useful Literature

Fastening and assembling with Truarc retaining rings is described in a 128-page technical manual offered by Waldes Kohinoor, Inc. Rings,

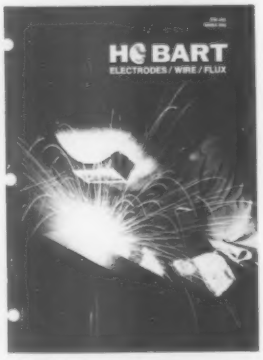
applicators, and dispensers are covered.
Circle 643.

Metric retaining rings in six popular types are described in a 20-page brochure.
Circle 644.

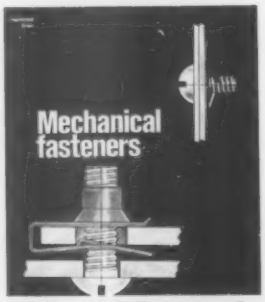
Aluminum threaded fasteners, and how to select and use them, are described in a 62-page engineering handbook available from Aluminum Co. of America.
Circle 646.



Aluminum rivets are shown and riveting applications are discussed in a 56-page brochure.
Circle 647.



Welding electrodes, wires, and flux are listed with specifications and recommended applications in a 44-page catalog offered by Hobart Brothers Co.
Circle 648.



Mechanical fasteners for assembling plastic parts

Back of Every AMERICAN RIVET is a 75-Year REPUTATION for EXCELLENCE in QUALITY...SERVICE ...ON-TIME DELIVERY

Down through the years AMERICAN RIVET has taken great pride in the manufacture of the finest quality tubular rivets and specials.

Coupled with this is the thoroughness and zeal in which we service every order, and the outstanding record we have earned in making deliveries on time.

Creative imagination in solving riveting problems is another plus value that dates back to the turn of the century.

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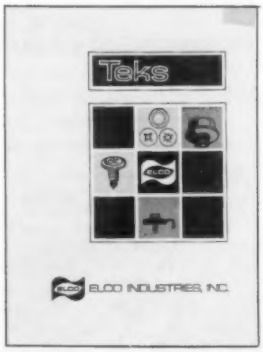
are discussed in an 8-page brochure available from Palnut Div. of TRW Inc. *Circle 658.*



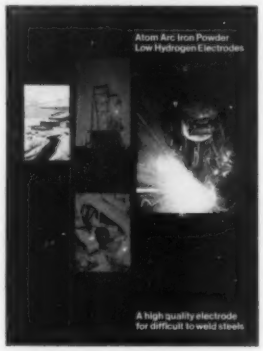
Self-drilling fasteners and examples of their applications are shown in a 12-page brochure available from Elco Industries, Inc. *Circle 660.*

Swageform fasteners that eliminate tapping and reduce driving torque are presented in a 6-page brochure. *Circle 661.*

The Torx fastener drive system in which one socket size fits four fastener sizes is described in a 6-page brochure. *Circle 662.*

Self-tapping fasteners which seat and seal every time, even when driven at an off-center angle of up to 15 degrees, are described in an 8-page brochure. *Circle 663.*

A self-locking fastener thread form and its performance in various materials and tapped holes are described in a 6-page brochure available from Holo-Krome. *Circle 675.*



Iron powder low hydrogen electrodes for welding all types of low alloy high tensile steel along with welding instructions and a guide to electrode application are presented in a 16-page brochure by Chemetron Welding Products. *Circle 677.*

Stainless steel electrodes that can bring together stainless steels of similar or dissimilar compositions are described in a 14-page brochure. *Circle 678.*

Dual shield flux-cored electrodes for welding all types of mild and low alloy steels are described in a 26-page brochure. *Circle 679.*

Spoolarc copper and copper alloy continuous bare electrodes for welding copper base and some ferrous metals are described in a 4-page brochure. *Circle 680.*

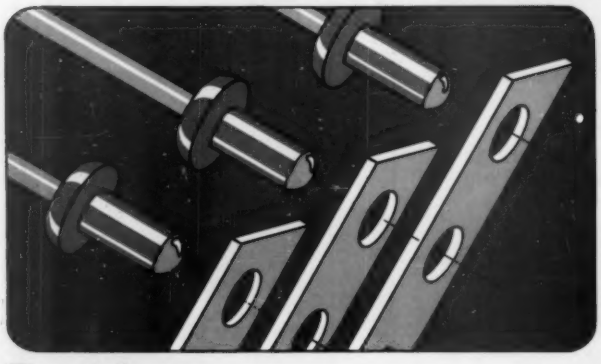
Spoolarc mild steel continuous bare electrodes, copper coated for protection and longer shelf life,

(continued)

The Last Chance Rivet

START WITH IT WHEN YOU CAN'T AFFORD FASTENING FAILURE

Fastening failure doesn't always mean a *fastener* failure. Often it's a result of shop error. The Avex® blind riveting system is designed to resolve the small errors before they create big problems—rework, scrap, and poor performance. It has been said that Avex is the rivet that "thinks for itself." These examples will show you why.



Problem: Two or more material thicknesses usually mean two or more fastener sizes are required. An incorrect diameter or grip range installed in error would create a need for rework.

No Problem: The Avex "non-grip sensitive" feature means that one size rivet joins a wide range of material thicknesses, reducing errors and inventories.

Problem: Oversized or irregular holes generally result in wasted *time* and *money*—scrap parts and a production slowdown. Holes would need to be prepared again in new components.

No Problem: During the placing sequence of an Avex rivet, the shell is caused to expand until it meets 360° contact with the hole in the parent material.

...and Avdel offers local distribution

AVDEL
50 Lackawanna Ave., Parsippany, N.J. 07054 201/263-8100

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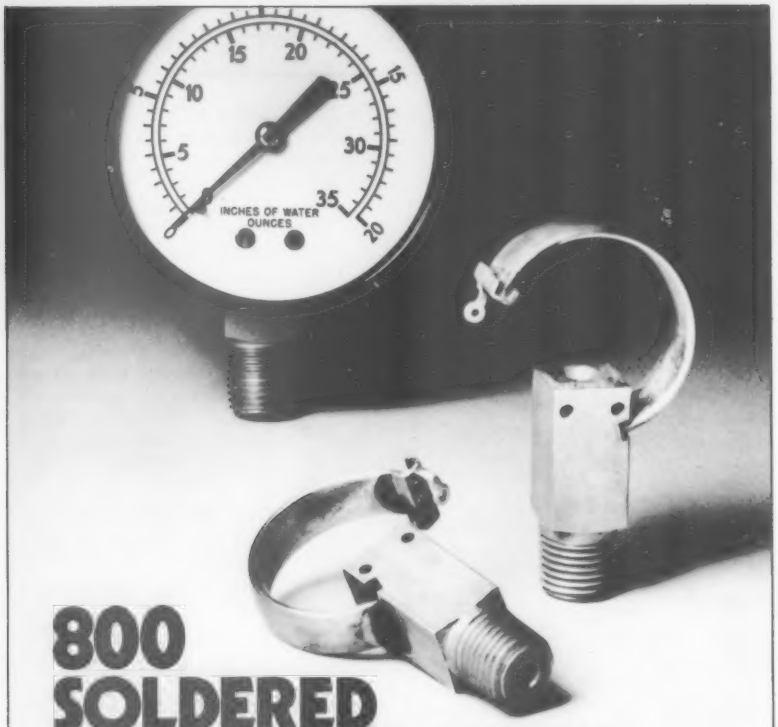
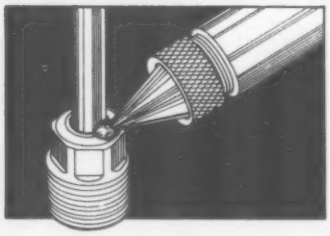


800 SOLDERED JOINTS PER HOUR ...Automatically!

A leading pressure gauge manufacturer curbed mounting labor costs by automatically joining 3-piece sensor assemblies with the Fusion Paste Process.* One unskilled operator loads the parts . . . Fusion's 12-station rotary machine deposits soldering alloy, completes precise heating and cooling functions for reliable, void-free joints. Elimination of rejects and manual steps helped justify machine cost in about 8 months.

Name Your Application . . . Fusion Brazing and Soldering Systems have helped reduce costs at thousands of assembly plants across the nation. Let us explain how Fusion Paste Alloys, equipment and design expertise can work together to achieve "Total Responsibility" for **your** brazing or soldering operation. Write or call for details.



* **Fusion Paste Brazing and Soldering:** Finely pulverized metal alloy, proper flux, and a paste-like binder are blended together for automatic deposit on parts to be joined. Eliminates pre-fluxing, insures precise measurement of joining compound for consistent joint quality at lowest possible cost!

FUSION INCORPORATED
4658 East 355th St. • Willoughby, Ohio 44094
Phone (216) 946-3300

FUSION

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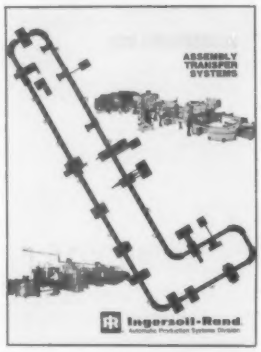
Useful Literature

(continued)

are described in a 4-page brochure.
Circle 681.



Nonsynchronous assembly transfer systems that combine automatic and manual operations for top efficiency are described in a 4-page brochure offered by Ingersoll-Rand.
Circle 682.

Six ways to clamp a joint with threaded fasteners is presented in a 4-page Imagineering bulletin.
Circle 683.

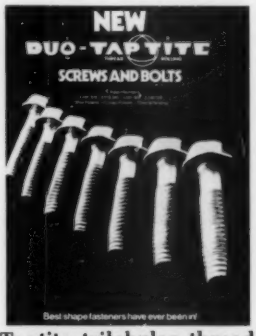
Riveting systems, and rivets for blind or limited access jobs, are described in a 30-page brochure available from Townsend Div. of Textron Inc.
Circle 684.

Perma-Pull internally tapped fasteners and air-powered hand tools are described in an 8-page brochure.
Circle 685.

Fastener application ideas and applications are shown in a package of individual data sheets, each illustrating a different case.
Circle 686.

Fab-Lok fasteners for roofing, siding, and other applications are described in a 6-page brochure.
Circle 687.

A clean-air weld system that removes weld smoke at the arc is described in a 4-page brochure offered by Bernard Div., Dover Corp.
Circle 659.

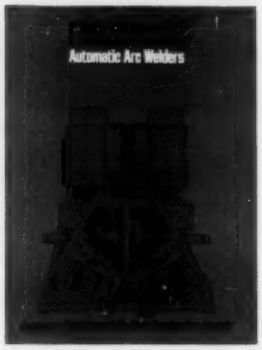


Taptite trilobular thread rolling screws and bolts are described in a 4-page brochure available from Continental Screw Co.
Circle 690.

High strength thread rolling bolts and screws are described in a 4-page brochure.
Circle 691.

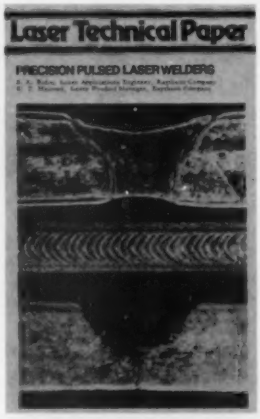
Hex washer head screws and bolts are described in a 4-page brochure.
Circle 692.

Thread rolling screws for plastics are described in a single-sheet bulletin.
Circle 693.



Automatic arc welders engineered to suit specific production requirements are described in an 8-page brochure offered by Teledyne Precision-Cincinnati.
Circle 694.

Self-locking, self-sealing fasteners, and what you should know about them, is presented in a 6-page brochure by ND Industries.
Circle 645.



Precision pulsed laser welders and their applications are discussed in a paper presented in a 20-page booklet by Raytheon Co.
Circle 668.

Seam welding with high-
(continued)

Time is money.

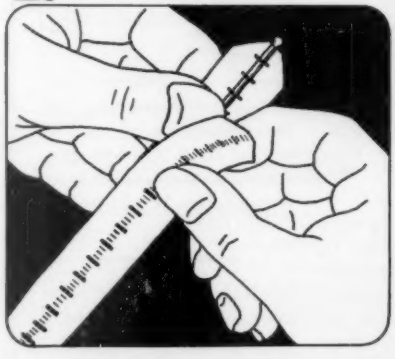
The Briv® blind riveting system was designed to save you valuable assembly time. The placing tool holds a magazine of rivets *inside* its barrel and feeds and places them automatically. All you do is load the tool, find the pre-drilled hole in the work piece, and pull the trigger.

To load the tool, slip a reusable mandrel through the rivet cartridge, peel off the paper shell, insert the mandrel into the front jaws of the tool, and snap the jaws closed—it takes less than 30 seconds.

Don't think you're sacrificing ease of handling—our Briv pneumatic placing tool weighs only 5½ pounds and is contoured for easy handling and portability.

And the rivets are engineered to solve the toughest design and production problems. The tapered lead on the rivet's tail makes entry fast and easy. Briv rivets are strong enough to actually pull metals together and provide a high clinch.

1. Insert the reusable mandrel into rivet cartridge and peel away the paper shell.



2. Open the tool jaws, drop the mandrel of rivets into the barrel, and snap the jaws closed.

3. Insert the first rivet (protruding from the rivet nose piece) into a prepared hole and pull the trigger.

ASSEMBLY

...ask for a briv demonstration

AVDEL MEMBER ifi
50 Lackawanna Ave., Parsippany, N.J. 07054 201/263-8100

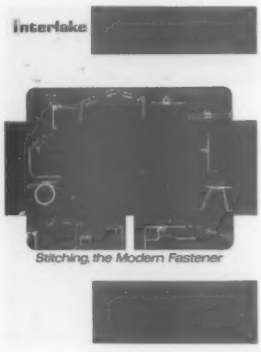
CIRCLE NO. 53 ON READER INQUIRY CARD

Useful Literature

(continued)

power, high pulse-rate YAG lasers is discussed in an 8-page paper.
Circle 669.

Laser welders/drillers for production applications are covered in a 6-page technical bulletin.
Circle 670.

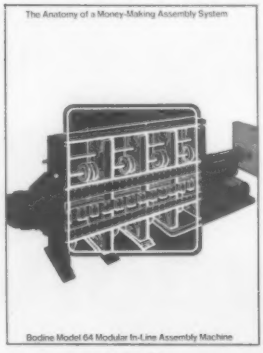


Wire stitching and its applications as an assembly method are shown in an 8-page brochure offered by Interlake, Inc.
Circle 650.

Weld fasteners, including a broad line of nuts, pins, and screws which can be permanently prepositioned by resistance welding, are presented in a comprehensive ring-binder catalog by Ohio Nut and Bolt Co.
Circle 665.

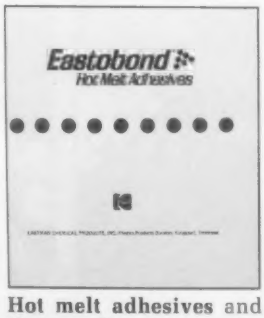
Metric-type weld fasteners are described in a 20-page catalog.
Circle 666.

An automatic welding machine for welding steel plate into structural sections with straight or tapered webs is described in a 30-page booklet offered by Conrac Corp.
Circle 696.



Automated in-line assembly systems are described in a 10-page brochure from The Bodine Corp.
Circle 697.

Guidelines to profitability in automatic machining and assembly are suggested in a 10-page bulletin.
Circle 698.



Hot melt adhesives and their applications are described in a 6-page brochure available from Eastman Chemical Products, Inc.
Circle 671.

Adhesives for specialty applications are described in a 4-page brochure.
Circle 672.

Clinch studs and application data are presented in a 6-page brochure offered by Camcar Div.
Circle 673.

The Brazing Book offered by Handy & Harman is a 52-page book discussing the advantages of brazing as a metal-joining method and presenting technical information on brazing procedures and materials.
Circle 674.

Automated brazing and soldering equipment is described in a 20-page brochure with a pocket containing additional information in the form of article reprints and data sheets, and is available

from Handy & Harman.
Circle 654.

Resistance welding galvanized steel is covered in a 6-page basic-guidelines brochure available from Armco Steel Corp.
Circle 656.

Industrial fasteners and their applications are presented in a 22-page general catalog available from Eaton Corp.
Circle 695.

Orbital forming of rivet heads is discussed in a 16-page booklet offered by VSI Automation.
Circle 664.

Solving spring design problems relating to high loads in limited space with Belleville spring washers is covered in a 12-page brochure available from Associated Spring.
Circle 667.

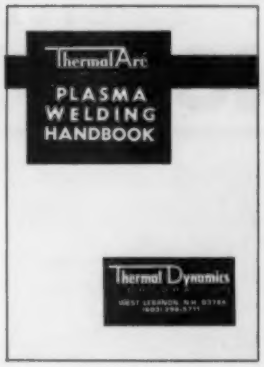
Blind rivets and a safety oriented pneumatic setting tool are presented in an 8-page technical bulletin offered by Milford Rivet & Machine Co.
Circle 657.

An automatic screwdriver reference chart suitable for wall mounting and giving pertinent data on 34 hand and bench models is available from Gubelin Industries, Inc.
Circle 649.

High-frequency welding processes and equipment for pipe and tube is described in an 8-page brochure by Thermatool Corp.
Circle 653.

Hydraulic clamping and positioning devices for assembly and machining operations are described in a 20-page brochure offered by Wilton Hydraulic Div.
Circle 676.

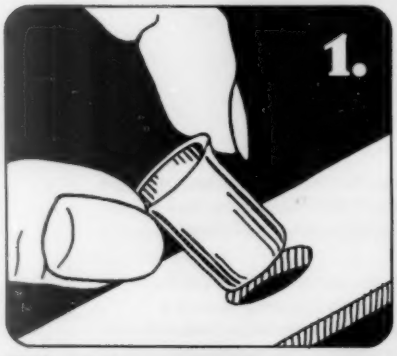
A power riveting system for joining multi-ply and steel cord belting with heavy-duty hinged fasteners is described in a 2-page bulletin by General Splice Corp.
Circle 652.



Plasma welding is presented in a 10-page handbook available from Thermal Dynamics Corp.
Circle 651.

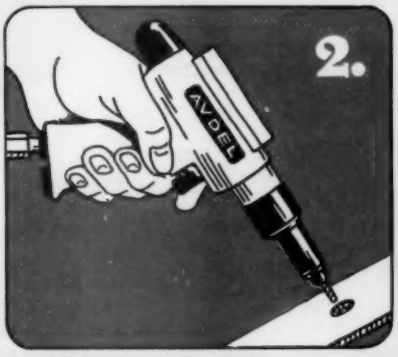
Finally!
A low-cost blind threaded insert!

The Thin Sheet Nutsert® System combines versatile blind threaded inserts with high-speed placing tools. When placed, the insert develops a large flange on the blind side of the workpiece, offering exceptional pull-out strengths. Their price is far less than competitive inserts. The efficiency and low cost of our tooling reduces in-place costs to a minimum . . . And no special skills or training is required. U.S. or metric threads are available.



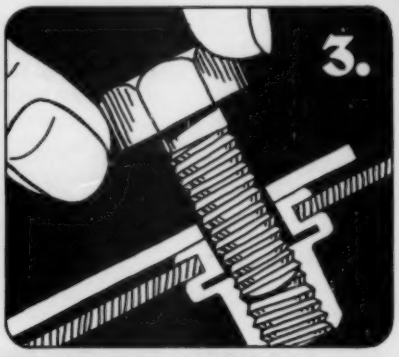
Blind installation...

TSN™ provides secure threads in materials generally too thin for tapping. Proven in plastic, aluminum, mild steel and fiberglass, it won't vibrate loose, even under extreme operating conditions.



In thin materials....

The entire process of setting a TSN is accomplished in one simple operation by one man, from one side of the work. Each TSN is uniformly placed in one second, as power tooling completely controls installation.



High-speed placing...

Pneumatic tooling (approx. ⅓ the cost of competitive equipment) is lightweight and portable, easily adapting to any production line. Hand tools and prototype kits are also available.

...and Avdel offers local distribution

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ASSEMBLY

LEADERS

NOT FOLLOWERS

Teledyne Firth Sterling FIRST with TC+

In 1970, Teledyne Firth Sterling introduced the first titanium nitride coated carbide — the "Golden Insert" — that immediately delivered longer tool life over a wider range of cutting applications with greater resistance to wear and cratering. Today, TC+ is widely copied, but it is still the leader.

Teledyne Firth Sterling FIRST with HN+

In 1976, Teledyne Firth Sterling proved again its leadership in cutting tool material know-how with the introduction of the Hafnium nitride coated carbide — HN+. This is the most metallurgically stable nitride or carbide coating known today, and it has exceptional high hot hardness.

AND NOW another new advance from Teledyne Firth Sterling

It's axiomatic that the efficiency of any cutting tool coating is directly related to the interface characteristics of the substrate upon which it is deposited.

Teledyne Firth Sterling is now producing inserts using a newly perfected base material with significantly improved resistance to thermal deformation. The immediate advantages — the feasibility of increasing speeds and feeds — and increasing the effective range of the cutting tool material itself.

Run your own tests, on your own machines. Teledyne Firth Sterling tool engineers are available to assist you in the best choice of cutting tool materials and toolholders for your operations.

TELEDYNE FIRTH STERLING
Four Parkway Center
Pittsburgh, PA 15220
Phone: 412/928-4500
TLX: 81-2413

CIRCLE NO. 55 ON READER INQUIRY CARD

Manufacturing PLANBOOK: 1978

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14 New Cincinnati Milacron 4-axis chucking and turning centers offer two seven-tool turrets on separate slides for an interference-free work zone up to full chuck diameter, 12", 15" and 18" chuck diameters. Various bed lengths. CNC control. Pages 56, 57

12 The Bullard VTLs. Vertical lathes from the 36" manual to the fully automated 124" Tool Block Changer. Send for catalog. Pages 52, 53

1 New four color brochure describes the new Kearney & Trecker MILWAUKEE-MATIC 800 which maximizes productivity of medium to large size workpieces. Also find out about the unique Diagnostic Communication System. Cover II

10 Over 650 tool & die shops have placed orders for Bridgeport Series I CNC Milling Machines since introduction in September, 1976. Why? Write for details and see for yourself. Page 47

20 Find out how Lucas can *remanufacture* your aging boring mill for about half the cost of a new one. Send for details. Page 65

18 The free "Inside Kingsbury" Brochure describes the many types of Kingsbury Machine Tools and gives background information on the company and services it offers. Pages 62, 63

16 The 12-page Catalog C-50K outlines the Super-Precision Production and Tool Room machines along with a list of Sales and Service representatives of Hardinge Brothers, Inc. Also request copies of Catalog 36, Bulletins HA-5, HA-202, HA-204 and HA-55 for complete information on Hardinge Collets. Page 60

22 Obtain a general catalog of H.E.S. equipment including standard, NC and CNC lathes, milling machines, Cri-Dan automatic threading lathes and massive turbine lathes and Liné Mills. Page 68

21 For detailed information on increased grinding productivity with Landis cylindrical grinders, write for specific machine catalogs. Pages 66, 67

CONTROLS

30 Allen-Bradley's Series 7300 CNC has *customized* features as a result of years of working with customers to meet specific requirements. Ask for Publication 7300-900 for details on these practical, easy-to-use features. Page 96

GAGING & INSPECTION

29 Marposs Gauges Corporation's new brochure details the new design of an almost indestructable in-process gauge with about 10% of the moving parts found in their original gauge heads. It is more durable and has a unique fluid damping systems to eliminate most vibration and impact problems. Page 94

MATERIALS HANDLING

46 The complete story of Unimate industrial robots . . . the machines that work for men who think. . . is contained in free brochure. Find out the least costly way to automate your conventional or NC machine tools. Page 142

CUTTING TOOLS

55 They introduced the first titanium nitride coated carbide in 1970; then, Hafnium nitride coated carbide in 1976, and are now producing inserts using a newly perfected base material with improved resistance to thermal deformation. Get additional information from Teledyne Firth Sterling. Page 160

60 A handy pocket-size guide from Morse helps you select the right tap for the right job. Get your copy of "Tap Selector Guide." Page 76

Circle No. **Description**

24 Something new in cubic boron nitride wheels—Bendix CBN *Gold* which beats heat in dry grinding tool steels and means more metal removal per pass. Get additional facts from Bendix Abrasives Division. Page 72

175-180 Guidelines on when to roll and when to cut threads, described in special 8-page bulletin from Teledyne Landis Machine. Pages 84, 85

26 They're available "off the shelf" for immediate delivery . . . Erickson's spade blades and holders. Read the six reasons why you should buy "Erickson" and request additional information. Page 80

HEAT TREATING

9 Marathon LeTourneau tells of the success they are having with a Hayes VSQ Vacuum Carburizing Furnace, which allows them to control surface carbon, carbon gradient and case depths and . . . reduce overall carburizing cycles. Page 32

FINISHING

45 Circle the number to receive literature illustrating and describing Spiratron vibratory finishing equipment . . . from Roto-Finish. Page 138

ASSEMBLY

47 The following literature is offered free by Hobart: 8-page Arc Welding Systems describes all *welders;* 44-page Electrodes/Wire/Flux with full details on all *filler metals*—plus charts; 28-page Arc Welding Accessories with details on all *accessories.* Page 145

52 Learn how Fusion paste soldering slashed assembly costs for a leading instrument manufacturer. Literature gives details on unique paste solder alloys, automated dispensers and equipment. Page 156

48 Many innovations have resulted from Camcar tackling fastening problems. Request information on their tamper-resistant self-drilling, self-tapping, self-sealing and locking fasteners which automatically limit torque. Page 146

51 When you can't afford a fastening failure, let Avex prevent problems with a blind riveting system designed to resolve small errors *before* they create big problems. Request additional details. Page 155

49 Townsend offers a sampling of their broad line of standard and special fasteners and systems by product, description and application. Write for new Capability Brochure for suggestions on reducing fastener costs. Pages 150, 151

50 A colorful brochure describes the many services offered by American Rivet in solving fastening problems; as well as complete specifications of standard semi-tubular rivets; and the design and application of cold head specials. Page 154

FORMING

37 Free Literature packet from Farrel, USM details how to pick the right injection molding machine for your job. They'll assist you by analyzing your product requirements and evaluating your material, die space, production and clamp requirements. Order your packet today! Page 116

42 A new 16 mm color sound film from Chambersburg Engineering Company—"Automated Forging Today and Tomorrow"—illustrates the production, safety, personnel and ecological benefits of the Model C Impacter. Page 126

38 Niagara's complete line of Series BP full eccentric shaft, blanking and progressive die presses, 150 thru 800 tons, especially suited for automatic operations, described in 24-page Bulletin 164. Page 118

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HOT LINE HAVE REPRESENTATIVE CALL IMMEDIATELY!

Manufacturing PLANBOOK: 1978

READER INQUIRY CARD

FOR FASTEST SERVICE, TRANSFER "PEEL OFF" MAILER LABEL FROM FRONT COVER TO ADDRESS AREA JUST BELOW

YOUR PHONE NUMBER: ( ) Area Code

Name Title

PLEASE PRINT ALL INFORMATION

Company Principal Products Mfd. (this location)

Division

Company Address (This Location)

STREET CITY STATE ZIP

APPROX. NO EMPLOYEES THIS PLANT:

1 ☐ under 25
2 ☐ 25-49
3 ☐ 50-99
4 ☐ 100-499
5 ☐ 500-999
6 ☐ 1000 plus

FOR PROMPT INFORMATION REGARDING ADVERTISEMENTS, NEW PRODUCTS OR NEW LITERATURE— CIRCLE NUMBERS BELOW WHICH APPEAR UNDER ITEM OF INTEREST.

ADVERTISEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
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FREE LITERATURE

181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
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Tackling today's tough jobs calls for steel that can take pressures and stresses unthinkable just a few years back.

At the Timken Company, we're doing plenty of research to make sure Timken® alloy steel is tough enough.

We're working on new alloy steels with more mettle than ever before. We're looking for ways to improve the surface finish, the internal structure and many of the other properties of existing kinds of steel.

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Timken alloy steel tubes, bars and billets. We never get too busy making steel to find ways of making it tougher.

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SPECIALTY ALLOY STEEL

Entry end of tube mill

Drawbench operator station

Forming section with removable stands

Tube mill welding section

Drawbench carriage completes draw

New Wean United ERW tube mill and drawbench produce electric weld and DOM tubing at Mid-West

Chicago-based Mid-West, a leader in cold drawn buttweld mechanical steel tubing, broadened its product range with the addition of this Wean United tube mill and drawbench.

Starting with coils of slit-to-width steel strip .095" to .284" thick, the mill forms, welds and sizes tubular products ranging from 2" to 6⅝" OD. Both the forming and sizing sections are designed for quick-change, using our standard interchangeable mill stands, to minimize downtime for product size changes.

A "constant circumference" weld pressure roll mechanism accurately aligns the strip edges for high frequency welding of the seam. The weld is scarfed inside and out, providing smooth surfaces for subsequent cold drawing. Ultrasonic testing continuously monitors weld quality.

A digital control, flying saw cuts lengths from 16' to 48'. The tubing can be sold "as welded" or it can be normalized then cold drawn.

In the drawbench, the tubing is drawn through a die and over a mandrel to achieve better dimensional accuracy and surface finish, increase mechanical strength, and improve machinability. The single-chain design drawbench has a 400 hp drive motor that generates a pulling force of 150,000 pounds. It draws tubing up to 6½" OD and 45' long.

We'd like to tell you more. Contact Wean United, Inc., Bar and Tubular Products Sales, 3805 Henricks Road, P.O. Box 180, Youngstown, Ohio 44501.

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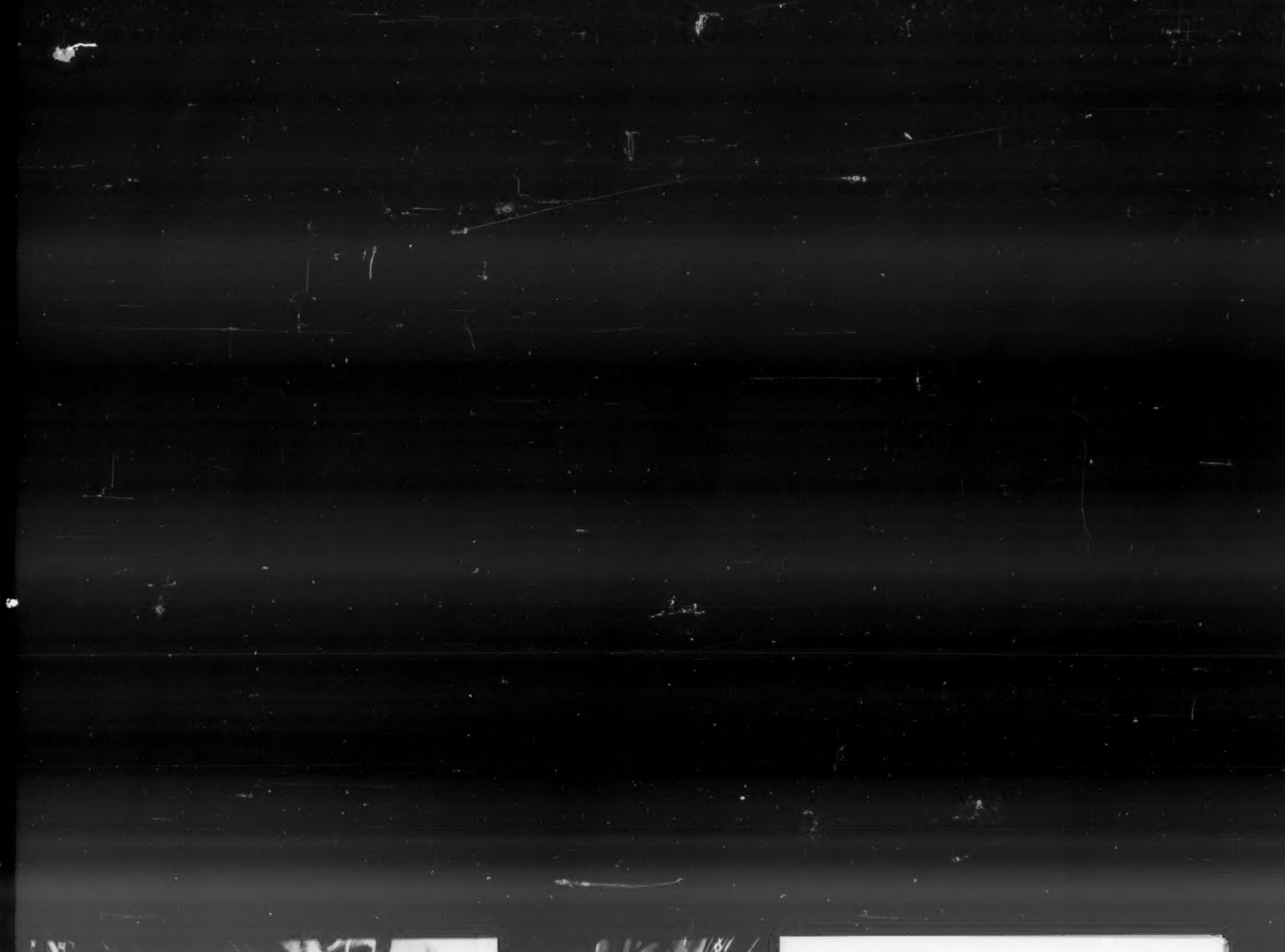
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